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CONSERVATIVE SURGERY,

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SOME OF THE

MECHANICAL CAUSES THAT OPERATE INJURIOUSLY

BOTH IN

HEALTH AND DISEASE.

WITH ILLUSTRATIONS.

BY

HENRY G. DAVIS, M. D.,

MEMBER OF THE AMERICAN MEDICAL ASSOCIATION, ETC., ETC.

"This, then, is the mode of cure, and it neither requires cutting, burning, nor any other complex means"—Hippocrates, Sydenham Society's Translation, vol. I., p. 632.

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INTRODUCTION.

THE records we here present to the profession are the gradual accumulations of over thirty years' investigation. It may be thought that the amount is meagre, in comparison to the time spent; but it must be remembered in extenuation, that we are but pioneers in this boundless field, and that each new discovery, effecting, as it does in many instances, an entire revolution in the pathology and treatment of the difficulty, must necessarily require a long time to test, by experience, its truth.

These results embrace causes and remedies that would only be suggested to one possessed of large mechanical ingenuity, or a faculty by which mechanical causes are recognized. This faculty becomes as indispensable in this department as an eye capable of distinguishing colors is to the painter.

The endeavor has been to discover and elucidate principles; hence, any success attained possesses a value in proportion as the subjects embraced by a principle are of advantage to man in promoting his happiness, or in prolonging his life. Principles in surgery may cover a large class of cases, whereas, manipulations or an operation may be applicable to a given case only.

It is not probable that in every instance the best means has been devised for accomplishing the object desired; for, we are like a traveller, crossing for the first time a vast, unexplored region—although it may afterwards be ascertained that he has not selected the best, yet it is much to demonstrate that it can be traversed by any route.

We could wish for another term of life than that allotted to man, to enable us to continue these investigations; as this cannot be, we hope that they will be resumed by one more capable, and pursued until the whole field has been explored.

HENRY G. DAVIS, M. D.,
54 EAST 23D STREET, NEW YORK.

CONSERVATIVE

OR

MECHANICAL SURGERY.

FRACTURES.

THERE is no branch of surgery where it is so difficult to introduce any innovation upon old and received plans, as in the one under consideration. The frequent legal prosecutions in some communities, for any result short of perfect restoration, renders it peculiarly hazardous for a surgeon to dress a fracture in any manner that the books have not sanctioned. Although the surgeon may be perfectly satisfied that he knows, or has devised, a way vastly superior to the old methods, yet prudence will often restrain him from putting it in practice. It requires, in addition to a firm conviction of the superiority of a new mode, an unusual degree of courage on the part of the surgeon to adopt it. We have mentioned this difficulty, that the profession may more fully appreciate their indebtedness to Gurdon Buck, M. D., of this city, for having successfully applied the principle of "continued elastic extension" to the treatment of fractures of the femur, the results of which he has given to the profession in a pamphlet form. The delay incident to the introduction of a change so radical will be more apparent, when we state that this principle of treating fractures by simple "continued elastic extension" was *urged by us upon the profession* in the early part of the year 1856, and yet it was not generally recognized until applied by Dr. Buck in 1860. Dr. Swinburne, now of this city, has done very much to prepare the way, and is deserving of all praise, yet he did not apparently fully appreciate the principle, as given by us in 1856, in the American Medical Monthly, May number, page 330.

When the fracture is transverse, the amount of extension will be less important than when the bones themselves do not prevent retraction. When the bones do not prevent shortening, by reason of the obliquity of the fracture, then the amount of extension becomes important, as it must be sufficient to prevent any shortening of the limb, yet must not exceed this point.

Thers is, however, but little danger of effecting any permanent injury from this cause, for the muscles will immediately remedy it whenever the weight is lessened or removed. Again, it requires time to effect a permanent lengthening of all the tissues surrounding a bone. The only other caution to be observed in treating by this plan is, to see that nothing prevents the limb from assuming its natural direction when the time approaches for bony union. This mode of extension of itself tends to bring the limb into its normal position, and we have only to see that nothing interferes to prevent it. It acts as directly upon the limb for this purpose as extension upon the two ends of a cord tends to bring it straight. In fractures of the humerus, or of the bones of the lower arm, extension can be secured by a weight near or in the hand, but held to the arm by adhesive straps, thus enabling the patient to be out during the day. At night the extension can be by a weight, cord, and pulley. This is the most simple plan. A splint can be arranged upon the arm, with a pulley at the lower end, and rubber webbing on the outside of the splint, as an extending force. In fractures of the patella, &c., we give a new plan of applying the adhesive plasters over the bellies of the muscles, and then make the extension as before. This plan will be given in detail under the treatment of fractures of the patella and other bones and processes. It is not our design to give the particular way of treating each individual fracture, but to give a principle, applicable to the treatment of fractures in general. Our time being so constantly occupied with those difficulties in which we have changed the mode of treatment, it has left but little to devote to ordinary fractures; hence we have not an array of cases to present, showing the results of this mode; yet the effect of extension upon muscles and other soft tissues, when applied to the limbs for other purposes, leaves us without a doubt as to its effect in fractures, as it is the contraction of muscles for which we apply extension in both cases.

It will enable the reader to understand more fully why this treatment of fractures by extension alone is effectual, if we show more clearly its effect upon the bone, and the soft parts surrounding the fracture.

After continued elastic extension has been applied to a fractured limb with sufficient force, and for a sufficient length of time to weary the muscles, all the tissues surrounding the fracture will be drawn tense. While in this position, and tense, they act and serve as so many splints, exerting a uniform pressure to force the parts, in a simple fracture, into their natural position, and, so long as they remain tense, they prevent any displacement. When the bone is comminuted, unless the fragments are isolated, and detached from the tissues that adhered to them when in their place, the extension, acting upon the tissues adherent to the fragments, will tend to draw them into their relative positions with the principal bone. The soft tissues act as so many fixtures drawing them into their places. Again, this mode of extension prevents the fractured pieces of bone from wounding the soft tissues surrounding the fracture.

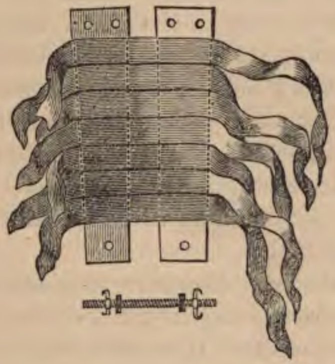
This thrusting of the fragments into the soft parts not only produces great pain and irritation, but actually increases the injury already inflicted by the accident. As a profession, we are not sufficiently aware of the ultimate effect of continued suffering,—of how many lives are lost that might have been saved, had their limbs or wounds been so dressed, and their surroundings so arranged after a severe accident, or an operation, as to render them actually free from pain, or from any discomfort even. There is scarce a fractured limb that can not be so dressed and arranged as to enable the patient to rest quietly, and take his regular meals with a good appetite.

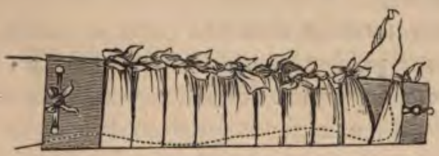
It will not be supposed that we include injuries of organs essential to life, that can not be placed at rest.

If this freedom from suffering could have been secured to our wounded soldiers, we can not but think a large portion of the amputations would have been unnecessary. By this we would not be understood as imputing any negligence or want of care on the part of our army surgeons; the circumstances under which both the surgeon and the patients are placed, after a battle, preclude that attention which could be readily bestowed upon a single case in private practice.

It is evident that the discharge from any wound, if the parts were free from every irritating cause, would not be sufficient to destroy life. It is when we add to this, continued suffering, loss of sleep and rest, loss of appetite and consequently nutrition, that we see our patients waste away. We have so frequently observed the change effected in patients, suffering from evils which were considered inevitable, when they were rendered free from pain and in every way comfortable, by a change in their dressings or surroundings, that we cannot avoid calling the attention of our brethren to the subject. Did we deem it advisable, we could give the history of cases to show the change we have mentioned. We give a cut of a simple apparatus for supporting the leg, one that can be easily extemporized at any farm-house. By rendering it more elaborate, the principle can be applied to the support of the whole body.

It consists of two strips of board, a little longer and wider than the parts to be supported. Upon them are placed the many-tailed bandage, with one long end to pass under the whole and fasten to the other end, on the opposite side of the splint. Upon the bandages may be placed cushions over the splints, that the sides of the limb may rest against. The long ends of the bandage are now carried around the splints under the limb, and secured as mentioned. The limb is now suspended by the inside loop of each strip of bandage, making a complete floor for it to rest upon.





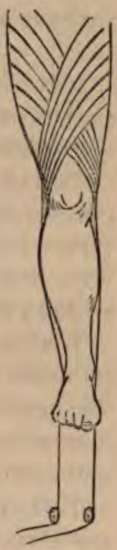
FRACTURE OF THE PATELLA.

The success heretofore in treating this fracture has not been so uniform as to render the offering of a new mode a surperfluous labor. Dr. Sanborn, of Lowell, Mass., has devised the most simple process for securing bony union in these cases. Yet he has not recognized the *principle* by which the contraction of muscles can be overcome in all similar cases,—a principle applicable in all cases, when the part broken off is so small as to render it impossible to make extension by it, or in those cases where it would be inconvenient to do so. The principle has never before been recognized, and was first applied by us in overcoming muscular deformities. It affects the muscles in a way that entirely prevents any contraction of their fibers, and does it without inflicting upon the patient any inconvenience from the application. We have in another place shown, that when adhesive plaster is applied over the bellies of muscles, and extension made therefrom, the effect in restraining the action of the muscle, is the same as when extension is made from the bone into which the muscle is inserted.

In applying this principle to overcoming the contraction of the muscles inserted into the patella, and which causes separation of the fractured bone, we do not interfere with any device the surgeon may wish applied for securing the fragments in apposition.

The accompanying cut illustrates the manner in which the adhesive plasters are applied over the bellies of the muscles.

It will be noticed that they commence at each side of the knee-joint, and spread out, in a fan shape, over the surface of the muscles attached to the patella. Another wide piece of plaster should be placed upon the front of the tibia, for a purpose to be hereafter described. The whole should be firmly secured to the limb by a roller



bandage, from the foot to the pelvis, omitting the knee. Any strong webbing can now be sewn to the ends of the plasters, as they lap upon each other by the knee, on both sides. This can be done before or after the roller is applied. We have sometimes used a piece of plaster 2½ inches wide and 15 or 18 inches long, for an adult, placing one end (with an inch turned upon itself, to strengthen it where the strap is to be sewn) about 2½ inches above the patella, and on the side of the limb, carrying it under and around the limb toward the pelvis in a spiral direction. Another in the same manner upon the other side. These are over the first-mentioned plasters, and applied before the roller.

To these spiral plasters can be sewn a piece of webbing, with a buckle in the center, facing towards the patella. To the plaster on the tibia, another piece of webbing is to be sewn, opposite the buckle, and directly in a line with the center of the patella.

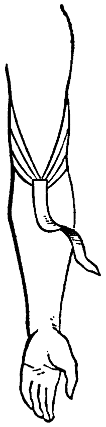
From the webbing on each side of the limb a cord passes over a pulley at the foot of the bed, one pulley for each cord, sufficiently far apart to allow the foot to rest between them. The cords and pulleys are separate, in order to prevent the loss of extension if the foot should come down against the foot-board, which it is liable to do in the night. After extension has brought down the muscles, leaving the fractured portion perfectly free to be placed in apposition, and after the swelling has somewhat subsided, a roll of bandage, 1 or 1½ inches thick, and not very hard, is to be placed crosswise above and below each fragment of the patella, and the webbing mentioned secured to the buckle over them, thus pressing the fragments closely together. This can be tightened as the parts yield, cautioning the patient to watch it. The limb can be placed in the fracture-box we have described, or well and evenly supported upon the bed.

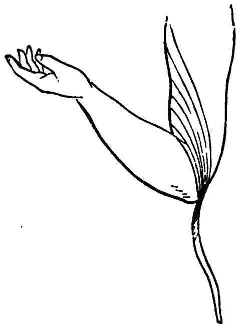
It is very desirable that this be well done at first, that the patient shall not feel uneasy, and be constantly changing his position to be comfortable.

This plan so effectually overcomes the contraction of the muscles, and leaves the patella so free to be kept in apposition, we can but think the vast majority of fractures of this bone will unite by bone. It is certain they will not fail to do so from want of coaptation of parts.

We have at present a case under treatment, that exhibits every thing desirable thus far, having united by bone. The patella was fractured by the force of the muscles, the man stepping in the night off the second stair from the bottom and striking on his heels, without falling.

This case has a weight of four pounds upon each side ot the limb. Were it not for the confinement, the patient could not be said to be incommoded by the treatment.





The above cuts exhibit the manner of applying the adhesive plasters over the bellies of muscles, in cases of fracture of the processes about the elbow. This mode of making the extension, by compressing and at the same time drawing down the muscle, in all those cases where the process is fractured, into which the muscle or muscles are inserted, will be an invaluable acquisition to the surgeon, and of great advantage to the patient, if it enables the surgeon to secure bony union in these cases. Formerly we were possessed of no reliable means whereby we could bring the fractured process into its place and be in any wise confident of its remaining. With this improvement, we may hope to see most cases unite by bone.

In addition to the fractures, in the treatment of which we have fully explained the manner of applying the extension, we will state some of the most important localities where the plan is applicable: fractures of the great trochanters, fractures of the os calcis, and many times it might be advisable to apply it to the muscles in fractures of the femur, &c. In the treatment of muscular deformities, and in some cases of diseases of joints, particularly the ankle, this mode can be used to the best advantage.

INTRA-CAPSULAR FRACTURES.

The neck of the femur is liable to be fractured within the capsular ligament at various portions of this part of the bone, but usually at a short distance below the head or between the head and center of the neck, where the compact structure is not so strong as at other portions, and where in consequence a slighter force is required to produce fracture. The fracture may occur just above the attachment of the capsular ligament, or the upper fragment may consist of the globular head, the line of fracture being just on a level with its base.

Sometimes, again, the fracture may be both within and without the capsular ligament, extending in an oblique direction, or inclining more or less to a perpendicular from within the capsular ligament down the shaft of the bone. This is more liable to occur when the neck, in consequence of disease or age, forms a right angle with the shaft of the femur.

This variety of fracture, as a general rule, does not occur before the age of fifty, at which period of life its spongy and compact tissues suffer from atrophy and fatty degeneration, which render it more or less brittle and unable to resist force; and hence the cause of intra-capsular fracture is generally some accident quite trivial as compared with the amount of force which may be sustained with impunity previous to the degeneration of the neck of this bone. It has been known to occur from a blow upon the hip, when the thigh was fixed and separated from its fellow, which placed it in a position where the strain came principally upon the upper portion of the bone; also, from a fall upon the great trochanter; or from catching the toes in a carpet while walking. According to Sir Astley Cooper, it occurs in London most frequently from the foot suddenly slipping off the edge of the sidewalk over the curb-stone upon the street pavement, the weight of the body being thereby thrown forcibly upon the neck of the bone in a perpendicular direction, when it is unprepared for such an event.

Cases of this variety of fracture have been known to occur in consequence of the individual having turned in bed in an unusual manner, powerfully twisting the thigh-bone; and also from having stepped from the bed upon the floor in a manner to twist the limb more than usual. Although the great majority of these fractures occur after fifty years of age, they may happen in younger patients; Sir Astley Cooper mentions a case which occurred at the age of thirty-eight, and Mr. Stanley, of London, reports an accident of this kind which happened to a lady eighteen years of age.

It has been noticed, as far as statistics on this subject have been examined, that this species of fracture is more frequent in females than males; which is attributed to the more nearly horizontal position of the neck of the thigh-bone, and the greater amount of atrophy and fatty degeneration of this portion of bone in old females than in old males. It is not unusual for this variety of fracture to be complicated with fracture of the neck of the femur outside of the capsular ligament, the lines of disjunction running into each other. It is possible for intra-capsular fracture to be complicated with fracture of the great trochanter, but this is rare, as in twenty-three specimens of this casualty in the Dupuytren Museum, Paris, there is no example of this association.

SYMPTOMS.

The symptoms of this lesion are: Peculiarity of the patient's body in the erect position. Pain at the site of the injury. Change of position in the great trochanter. Crepitation. Preternatural mobility. Eversion of the foot. Shortening of the thigh.

When the patient stands up, the body is inclined forward in such manner as to throw its weight upon the sound limb, which is placed firmly to sustain the weight of the body, while the fractured one hangs off in an unnatural position, with the foot and knee strongly everted; the leg is supported upon the ball of the toes, with the heel elevated from two to three inches; the hip is unnaturally flat, and any attempt to walk or raise the limb produces pain at the site of the injury.

This pain at the site of injury, although common to all fractures, is of particular value only in connection with the other symptoms. It is located at the upper and inner part of the thigh, in the direction of the trochanter minor, and is greatly increased whenever attempts are made to rotate the limb, to bend it upon the pelvis, or to carry it inward over the sound one. The suffering is generally very trivial when the patient is perfectly quiet, with the limb placed in a relaxed position, unless the bone has received severe concussion along with the fracture, when the pain will frequently be very severe, and is generally worse at night than in the day-time.

The change in the position of the great trochanter is a symptom of importance in this variety of fracture. This bony protuberance is not only drawn upward toward the ilium, but is brought in close contact with the border of the acetabulum, and consequently is much less easily seen and felt than in the natural condition of the parts, in which latter it is usually so conspicuous.

The great trochanter will be found to turn, as it were, upon a pivot, or to move in a segment of a circle of less diameter than natural, when the thigh is rotated upon its axis by taking hold of the foot.

Crepitation, which is common to all fractures, and one of the most important diagnostic accompaniments, is very rarely wanting in intra-capsular fractures, and is only wanting in cases where impaction of the broken ends of the bone has occurred, or where the ends of the bony fragments still remain more or less in apposition with each other. It may be detected at once after the occurrence of the fracture, and will continue discoverable so long as the fracture remains ununited.

To produce it, it will be necessary to rotate the limb, and bring the broken ends of the bone fully in attrition under extension and counter-extension.

Preternatural mobility is an important diagnostic sign of this fracture, as it is, indeed, of all fractures, and is especially noticeable in the intra-capsular variety, except in those cases where impaction of the fractured ends of the bone has occurred, or the ends of the bone are held in apposition by interlocking of their roughened fragments, or from incompleteness of the solution of continuity. Its extent may be ascertained by taking hold of the limb and rotating it upon its axis, flexing it upon the pelvis, carrying it behind the line of the sound limb, or inward or outward, which movements cannot be performed where there is dislocation of the head of the femur. The limb may be restored to its natural length by extension and counter-extension; but as soon as these are discontinued, the shortening recurs.

Eversion of the foot, and, in fact, of the whole limb, is a strikingly constant symptom of intra-capsular fractures, being rarely absent in any case.

In the standing position, it is such as to cause the heel of the fractured limb to be directed toward the hollow between the ankle and tendo-Achillis of the sound limb. When lying down, the foot drops outward almost horizontally, inclining nearly to a level, and in contact with the surface of the couch upon which the patient is placed.

This eversion is generally an immediate effect of the fracture; but, in cases where the ends of the fragments of bone are impacted, or otherwise held together, it may not occur for some time, or not at all; or the foot and knee may, from impaction, be more or less turned in the opposite direction.

The occurrence of eversion of the limb in this fracture has been differently accounted for by authors; some ascribing it to the action of the external rotator muscles, which, being connected with the upper extremity of the bone, by contracting, roll the thigh outward, after it has lost its support above from severance of this fragment with that entering into the articulation with the acetabulum. Others attribute it to the weight of the foot alone, which has a natural tendency to roll outward, especially as is noticed in sleep, the foot invariably, in a sound condition, turning over, so that its outer margin almost touches the surface of the couch.

Shortening of the thigh is one of the most constant features attendant upon this variety of fracture, and is therefore a valuable sign, and one which is usually first noticed, though not always present.

The degree of shortening varies in different cases, and in different conditions of the same case, its extent being greatly influenced by the integrity of the capsular ligament, being greater where the capsular ligament is ruptured.

The amount of shortening is less where there is impaction of the fractured ends of the bone; and it is also less immediately after the accident than after the lapse of several days, when the muscles, not being counteracted, have had time to contract. The amount of immediate shortening ranges from half an inch to an inch. It may be considerably less or more, reaching sometimes, when the capsular ligament has been ruptured, to an inch and a half. This may increase during the progress of the case to upward of two inches, and has been known to exceed three inches of shortening.

The shortening of the limb is usually immediate, though not always so; and, when not immediate, is probably more often attributable to want of separation of the ends of the fragments of the fractured bone than to lack of integrity of the capsular ligament. Where the ends of the bone have become interlocked with each other, the patient may be around upon the injured limb for several days, making considerable exertion upon it, without much shortening, until suddenly shortening may occur from some movement which disjoins the ends of the fragments.

In cases of impaction of the fragments, the shortening will be instantaneous, and will remain permanent, unless the junction be disturbed by the subsequent movements of the patient, or the efforts at extension by the surgeon to adjust the limb.

There is not generally much swelling in this variety of fracture, unless the hip has received a severe blow, sufficient to produce ecchymosis, effusion, and discoloration, which is not even then very lasting. The position of the neck of the femur and the great thickness of its muscular coverings very materially reduce the chances of this variety of fracture resulting as the effect of a direct blow, and it has been held that it can only happen from direct application, as the result of gunshot wounds, or other similar penetrating injuries. It is, therefore, broken almost invariably by indirect blows, aided, in old people, by muscular contraction.

M. Rodet maintains that the direction in which the force has acted will determine the situation and direction of the fracture. As, for instance, if the person has fallen upon the foot or knee, the fracture will be intra-capsular and oblique; if he falls upon the front of the trochanter, the fracture will be intra-capsular also, but transverse; if the back of the trochanter is struck, the fracture will be partly intra and partly extra capsular; and if the patient falls directly upon the side, or receives the blow fairly upon the outer side of the trochanter, the fracture will be entirely without the capsule.

There is no doubt that falls upon the feet or knees, in the majority of cases, produce intra-capsular fractures; and that falls upon the outside of the hip, or upon the trochanter major, generally cause extra-capsular fractures, if fracture be the result of such falls.

In the large majority of these fractures, the ends of the bones are so far separated as only partially to tear asunder the capsular ligament and periosteum; but in more severe cases, the bone is not only broken, but displaced to such an extent that the capsule is completely torn in two.

Great differences of opinion have been expressed as to the probability of the occurrence of bony union after a complete fracture of the neck of the femur within the capsule; and the subject is one which has engaged the attention of the ablest surgeons and pathologists for a long time.

These discrepancies of opinion have arisen from the uncertainty which attaches to the authenticity of the pathological specimens which have been produced by the advocates for either side of the proposition.

Dr. George K. Smith, of the Long Island College Hospital, has made a valuable contribution to our knowledge of the anatomy and pathology of the hip-joint, under the title of "Insertion of the Capsular Ligament of the Hip-Joint, and its Relation to Intra-capsular Fracture," in which he shows that anatomists have not hitherto correctly described the attachment of the capsule; that the capsule is seldom, if ever, attached at the same point in different persons, while it is as uniformly found attached at the same point in the opposite femurs of the same individual.

To determine, therefore, whether the line of fracture in any particular specimen was within or without the capsule, it is necessary to compare the fractured bone with its fellow of the opposite side, and not with the femur of another person. He shows, further, that after a fracture, and the consequent absorption of the neck of the bone, the normal position of the capsule is almost always changed, so that its present attachment does not necessarily show where were the points of its attachment before the fracture occurred; and also that the absorption proceeds irregularly and unequally, yet with great rapidity, in the two fragments; that if bony union ever takes place, it probably occurs subsequent to the arrest of the absorption; and therefore the line of union cannot in itself alone determine whether the fracture was near the head or near the trochanters.

When the circumstances are favorable which have relation to the several conditions of age, health, degree of separation of the fragments, laceration of the periosteum and capsule, there seems a probability that judicious treatment may effect bony union. Such favorable circumstances, however, are rare; and, unfortunately, if they do exist, the fracture is very liable not to be recognized by the surgeon, and consequently these advantages are not made available toward securing bony union.

Dupuytren states that, when the fragments are not displaced, "its existence may be suspected, but cannot be positively asserted."

The chief difficulties in the way of union by bone of fracture within the capsule are, that the persons to whom this accident occurs are generally advanced in life, and consequently the process of repair is slow and feeble. The head of the femur receives its supply of blood principally through the neck and reflected capsule, and, when both are severed, the small amount supplied by the round ligament is found to be insufficient. When the fragments are once displaced, it is difficult, if not impossible, to replace them.

The direction of the fracture is generally such that the ends of the fragments do not properly support and sustain each other when they are in apposition.

The fracture is at a point where the most powerful muscles in the body, acting with great advantage, tend to displace the ends of the broken bones.

As the subjects of this accident are generally aged persons, they do not bear well the necessary confinement, especially as the union requires generally a much longer time than the union of any other fracture; so that a persistence in the attempt to confine the patient the requisite time often produces exhaustion, and results fatally. It is extremely probable that the interposition of synovial fluid between the ends of the fragments of bone has much to do with preventing union by ossific deposit, whether by chemical change or dilution we are, of course, unable to determine. But we may be justified in assuming that the limited arterial nourishment supplied to the head of the femur, when fractured within the capsule, necessitates a very limited effusion of ossific matter from those fragments, and that the plastic properties of such ossific deposit as does occur are materially weakened by the contact with synovial fluid, which doubtless possesses some solvent powers.

Various changes occur to the displaced fragments as the result of failure to unite by osseous union. The acetabular fragment is generally rapidly absorbed as far as the head, and occasionally, also, a considerable portion of this latter disappears. The trochanteric fragment is found to have gained about as much generally in thickness as it has lost in length, and appears flattened out by pressure and friction. But there will be found many exceptions to this.

The trochanteric fragment sometimes forms an open, shallow socket, into which the acetabular fragment is received; or its extremity may be irregularly convex, working into a corresponding cavity in the acetabular fragment. These two fragments ordinarily move upon each other without the intervention of any substance. They often become united, more or less completely, by fibrous bands, of varying length in different cases, according to the amount of motion which has been maintained between the fragments while they were being formed.

The capsular ligaments are often found attached by firm bands to the acetabular fragment, and are usually considerably thickened and elongated in certain directions.

Among the invariable consequences of this fracture may be mentioned permanent shortening, either with or without eversion of the limb. Our prognosis in cases of fracture of the neck of the femur must always be unfavorable. Many succumb rapidly to the injury, perishing from a low, irritative fever, or from gradual exhaustion, within a month or two from its occurrence, whether the fracture has taken place within or external to the capsule. In either case the functions of the limb are forever impaired, whether it be united by ligament or bone, as shortening of the limb and lameness are the inevitable results.

As regards the question of repair of intra-capsular fractures, it may be stated that, under favorable circumstances, both as respects the patient and the treatment, there may be fibro-ligamentous union, answering the purpose of a sufficiently strong bond to admit of tolerable progression, after the subsidence of the more immediate effects of the accident.

When the patient is old, decrepit, or worn out by disease, and cannot consequently submit to the proper treatment, or when, although the system may be sufficiently vigorous, the case has not been judiciously managed, no consolidation will take place; but, on the other hand, the neck of the bone, or both the neck and head, will be absorbed, the limb remaining proportionably shortened and deformed.

Although osseous union is not altogether impossible, yet it is so exceedingly infrequent that it cannot be reasonably looked for in any case, however favorable the attending circumstances of skill on the part of the surgeon, and recuperative energies of the patient, may be.

A favorable termination will be most likely to happen in the impacted form of the fracture, especially if the patient is comparatively young and vigorous.

In the mixed variety of this fracture—that is, when it is partly within and partly without the capsular ligament —the mode of repair will be similar to that of ordinary fracture, although the process will require more time and care for its successful completion.

DIAGNOSIS.

As mistakes are liable to occur in determining between fracture of the neck of the femur, and other injuries in this situation, it becomes a matter of great importance, both to the patient and the practitioner, that the latter have correct conceptions of the real nature of the injury, errors of diagnosis here being especially prejudicial to both parties.

Fractures of this variety are most apt to be confounded with sprains and dislocations of the hip-joint; and in many cases great difficulty is experienced also in determining whether the injury is one of fracture within the capsular ligament or of fracture exterior to it.

Sprains and contusions of the hip, causing involuntary obliquity of the pelvis, with apparent shortening of the limb and eversion of the knee and foot, accompanied with excessive pain and difficulty of movement, sometimes so closely simulate the symptoms of fracture of the neck of the femur, especially the intra-capsular variety, as to give rise to great doubt and perplexity in the minds of the most skillful diagnosticians, and, among those not well informed, has often led to serious errors of practice by the resort to improper treatment.

The diagnostic symptoms are as follows:—

The shortening is real in fracture, and can only be counteracted and overcome by the maintenance of extension and counter-extension. On the contrary, in sprains and contusions, the shortening is not actual, but apparent, as may be proved by placing the limbs parallel with each other, and bringing the two iliac crests on the same level.

The eversion of the foot is complete in cases of this variety of fracture, and the extremity presents an appearance characteristic of total loss of power. The eversion is comparatively slight in ordinary injuries of the hip and upper part of the thigh, and the patient can rectify it by his own efforts, although it may cause considerable pain to do so. There is usually complete inability on the part of the patient to effect muscular action in cases of this fracture, so that the thigh can neither be extended, flexed, nor rotated. In the impacted form of the fracture, however, the individual has still some control over the limb, and the best guide for diagnosing is the existence of actual shortening. In sprains and contusions, the power of motion is diminished, but not altogether abolished.

DIFFERENTIAL DIAGNOSIS.

It would appear to be a very easy matter to diagnose between a case of intra-capsular fracture, a case of extra-capsular fracture, and a case of dislocation of the head of the femur upon the dorsum ilii; yet, that the one may be mistaken for the other, even in the hands of distinguished surgeons, is attested by numerous cases upon record; and to avoid such errors, it will be necessary to bear in mind the prominent features of each lesion.

Fracture within the capsule occurs nearly always in old persons, or those over fifty years of age, and is more frequent in females than in males.

Iliac dislocation is most common in adult and middle life, and occurs with equal frequency in both sexes.

Intra-capsular fracture is usually the result of slight causes, as a fall upon the foot or knee; whereas dislocation of the head of the femur upon the ilium is always produced by severe force.

In cases of intra-capsular fracture, the foot is strongly everted; but in cases of dislocation of the head of the femur upon the dorsum of the ilium, the foot is inverted.

In intra-capsular fracture there is great shortening of the limb, which is readily effaced by extension and counter-extension; but it recurs again immediately the extending force is discontinued. But in iliac dislocation, the shortening, although equally great, can be effaced only by restoring the bone to its natural position, when it will not recur.

In intra-capsular fracture there is usually marked crepitation; but there is no crepitation where the head of the bone is simply dislocated.

In intra-capsular fracture there is preternatural mobility of the affected limb, the ends of the fragments of the bone being freely movable upon each other; whereas, in dislocation of the femur, the bone is fixed and the limb is in a constrained position.

The greatest difficulty, however, arises in the diagnosis of these affections of the thigh and hip, from the embarrassment which the surgeon experiences in determining whether the case be one of intra-capsular fracture, or fracture exterior to the capsular ligament.

Fracture within the capsule is generally produced by slight violence, whereas fracture exterior to the capsule requires much greater force.

Fracture within the capsule is usually occasioned by a fall upon the foot or knee, as in stepping down, perhaps a few inches only, when the limb is unprepared for such movement; while fracture exterior to the capsule, on the other hand, is usually the result of a fall upon the trochanter major.

The period of life at which intra-capsular fracture generally occurs is over fifty years of age; but fracture exterior to the capsule more often occurs under this period of life.

Intra-capsular fractures occur more frequently in females than males; but the relative frequency in this respect has not been determined regarding the extra-capsular variety.

The amount of pain, tenderness, and swelling is inconsiderable in the intra-capsular variety of fracture, and what pain there is, is deeply seated. In the extra-capsular form, the pain, tenderness, and swelling are often great, and are superficial, and it is especially painful to the patient to press upon and around the trochanter major.

Measuring from the anterior superior spinous process of the ilium to the inner condyle of the femur, it will be found that there is often no shortening of the limb at first, in cases of intra-capsular fracture; but the same measurement, in cases exterior to the capsule, will always discover at once considerable shortening.

After a few days or weeks from the time of the accident, the shortening, in the intra-capsular variety, greatly increases, and sometimes takes place suddenly, as when the limb is moved or the patient steps upon it.

In the extra-capsular variety, the shortening changes but little, if at all, and, if impaction has occurred, remains stationary. Its extent is usually less than in the intra-capsular fracture.

In the intra-capsular fracture, there is more mobility of the limb than in the extra-capsular form.

In the intra-capsular form, crepitation is indistinct, and can only be fully elicited by extension and counter-extension.

In the extra-capsular form, crepitation is uncommonly distinct, being often loud and ringing, and is readily perceived on laying the hand on the trochanter and rotating the limb.

In the intra-capsular form, the function is much impaired, but not wholly abolished; but in the extra-capsular form the loss of power is complete, the limb lying in a helpless condition, as though paralyzed.

In the intra-capsular form, the trochanter major moves upon a longer radius on rotating the limb, as though it were upon a pivot; but, in the extra-capsular form, the trochanter moves upon a shorter radius. It is often partially separated from the shaft of the bone, and then but imperfectly obeys the movements of the limb.

In the intra-capsular form, there is generally little or no contusion, swelling, or discoloration; but in the extra-capsular form these evidences of greater violence are usually present.

If the patient recovers the use of the limb after the intra-capsular accident, it is not restored under three or four months; but, in the accident exterior to the capsule, the recovery may be effected in six or eight weeks.

In the intra-capsular form, there is no enlargement or apparent expansion of the trochanter major after recovery, from deposit of bony callus; whereas in the extra-capsular form there is enlargement or irregular expansion of the trochanter major, which may be felt sometimes distinctly through the skin and muscles.

In the intra-capsular form of the fracture, there may be progressive wasting of the limb for many months after recovery; but, in the extra-capsular variety, the limb usually preserves its natural strength and size.

In the intra-capsular form, there is considerable halting in the gait, attended with a peculiar motion of the pelvis, such as is exhibited in persons who walk with an artificial limb. In the extra-capsular form, there is slight halt, and the motions of the hip are natural.

In the impacted fracture of the neck of the femur, whether within the capsule or exterior to it, the most important diagnostic characters are shortening of the limb, the absence of crepitation, and the comparative or complete immobility of the fragments. The shortening is always immediate, and remains permanent in its original extent, unless the ends of the bone are rudely drawn asunder, and may be considered in the character of a most important diagnostic sign, as may also the absence of crepitation, and the trivial mobility or complete absence of motion. The principal liability is to mistake the impacted fracture for dislocation.

The general distinctive features between dislocation and fracture of the head and neck of the femur may be arrived at by attending to the fact of the limb being fixed in dislocation, and its mobility increased in fracture; the difficulty of reduction in dislocation, its ease in fracture; the continuance of the reduction, when once accomplished, in dislocation; its almost immediate recurrence in fracture, upon cessation of extension and counter-extension.

The absence of crepitation in dislocation and shortening being also more decided than in fracture; the position of the head of the bone, which rotates with the shaft in dislocation; and the age at which the accident has occurred, dislocation being an occurrence of middle age, and resulting from much more violence than is required in fracture of the head or neck of the femur, which latter usually is the result of slight causes.

It may also be necessary to diagnose this accident from fracture of the acetabulum, as well as to diagnose a dislocation of the head of the femur from fracture of the acetabulum, which latter is a much more serious injury, and is followed by more violent general effects; crepitation is very marked, and the renewed displacement of the bone takes place with great ease.

We have given very fully the views and opinions of the profession, with a few incidental comments of our own. In addition, we feel constrained to protest against a too common practice which prevails among surgeons, and one which is of the utmost importance in its bearings upon the casualty under consideration.

We allude to the inordinate desire to ascertain the fullest extent of the injury to the ilio-femoral articulation, and the unwarranted efforts made, by manipulations of the injured limb, to ascertain if there be fracture or not, and, if so, its particular character, direction, and extent.

Now, while we willingly concede the importance of a correct diagnosis in its bearings upon the successful treatment of any case, we hold that too much handling and manipulation of the limb in intra-capsular fracture is liable to eventuate in irreparable injury to the patient, as we will proceed to demonstrate.

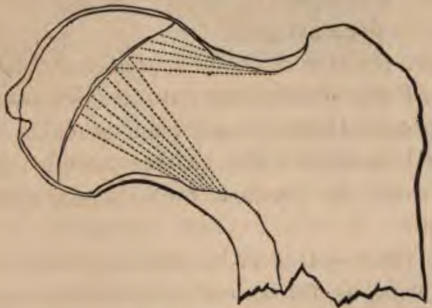
The relative position of the head and neck of the femur to the shaft of the bone in the natural erect posture, with the feet at proper distance from each other, is one admirably adapted to sustain the greatest weight, and consequently to resist the greatest force, when applied from below upward.

But if we reverse this order, and apply the force from above downward, as, for instance, in the direct application of a blow to the trochanter, we shall find in this latter condition that the bony structure is least able to resist the force so applied; and hence it is that this fracture is so very apt to follow upon a fall in which the patient strikes with the weight of the body impinging from above downward, the whole impetus and shock being received on the trochanter and neck of the bone, from a direction in which its shape, mechanically considered, is least able to successfully offer resistance.

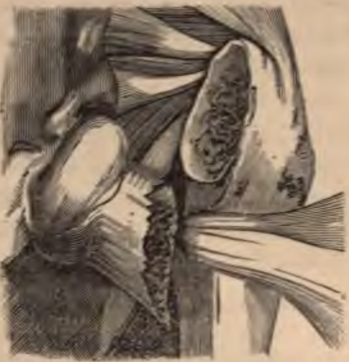
The head of the bone being held in the acetabulum, and the trochanter forced downward, brings the strain upon the neck in its most defenseless position.

The fracture commences upon the under side, extending transversely until it reaches a point near its upper surface, where the resistance will be least in a longitudinal direction. Hence it will split in a wedge shape, the apex of which may extend under the capsular ligament, retaining its connection, however, with the neck of the bone, through both the capsular ligament and the periosteum.

When the force is applied in the opposite direction, through the foot or knee, by a fall upon these parts, while the limb is strongly abducted, the fracture will commence at the upper side, and extend downward and outward, as represented in the cut, the lip extending more or less under the point of insertion of the capsular ligament.



In the above cut, taken from a section of a very large femur, the arrangement of the cancellated structure is well delineated. It will be noticed that the walls of the cancelli run from the buttress of compact bone that supports the neck, to that portion of the head on which the weight of the body rests. The same arrangement, but running in the opposite direction, exists at the upper portion of the neck. It is this direction of these braces of support to the head that mechanically disposes a fracture to split longitudinally, when it has traversed nearly through the neck. At a given point the bone is found weakest in this direction, and therefore splits rather than fractures across. We have this result in breaking a piece of wood: a portion, instead of fracturing, will follow the grain and split, finding less resistance in this direction than across.



The above cut of an intra-capsular fracture is taken from Doane's "Surgery Illustrated," second edition, published in New York in 1837. This was undoubtedly taken from the subject, as he, in a foot-note, says the shaft is drawn outward, in order to show the muscles at the posterior part. Again, an artist would never have delineated a fracture, without one before him, with a lip or wedge-shaped portion running out as this does. This form exists in too many cases to be accidental. The direction of the fracture in the cut is the one we should expect from the structure of the bone. Rodet, in his experiments upon the dead subject, maintains that, when the force is applied through the foot or knee, the fracture will be intra-capsular and *oblique*. This proves how the bone will break by a direct force. To render the comparison perfect, the action of the muscles should be added. As it is, it strongly corroborates our view, as he says the fracture is *oblique*.

Professor Hamilton, in his work on "Fractures and Dislocations," second edition, 1863, page 365, cut 108, shows this wedge-shaped termination of the acetabular portion of the bone, more marked even than in the cut from Doane's "Surgery." On page 369 of Professor Hamilton's work, he quotes Professor William H. Van Buren as saying, in his description of an intra-capsular fracture: "The direction of the fracture was *oblique*, commencing just at the articulating surface of the head, and ending just within the capsule." In this case, the fracture corresponds perfectly with what we suppose takes place in a large portion of fractures in this locality. We have very strong corroborative evidence of there being some point of ligamentous union of the two portions of bone, that at first effectually prevents displacement, in the fact that, in so large a number of cases, there is at first *no shortening*, and many times the shortening takes place in the hands of the surgeon, after active manipulation of the limb to discover crepitus. It will be exceedingly difficult to decide by the examination of cases that have died years after the receipt of the injury. Absorption not only changes the parts materially, but it affects the bones so differently in different cases.

It is upon this condition of the parts we lay great stress, and we particularly invite attention to it, since it is upon the preservation of this connection that we base hopes of better success in the results of treatment hereafter in cases of intra-capsular fracture.

When this connecting link of periosteum and capsular ligament is not severed by officious handling on the part of the surgeon, in his zealous but often mischievous efforts to ascertain to the fullest extent the details of the injury, then we may hope for better results than have usually followed this accident.

That every intra-capsular fracture will take this course, and have a fragment of the fractured bone extending under the insertion of the capsular ligament, of course is not to be expected. What we would enforce is, that it is extremely probable that a large proportion of the cases are so circumstanced at the time of the accident, and before the limb has been disturbed, either by the surgeon in his examination, or by the attendants in removing the patient from the scene of the injury.

The importance of this small fragment of bone will readily be appreciated, when we reflect that by it we have a connection by means of which, and a point at which, ossific union *can* commence.

It will be readily perceived how easily this small, wedge-shaped fragment of bone, with its periosteal and ligamentous attachment, may be torn asunder, leaving the head of the femur entirely isolated from the shaft, its only source of nourishment being then through the vessels of the round ligament; and if this supply of nourishment were many times what it is, we do not think it would be sufficient to effect ossific union. But if this fragment be not deprived of its capsular and periosteal connections, we see no reason why ossific union would not commence at this point.

If our theory be correct, it is only when some point of periosteal or capsular connection is maintained with the neck that ossific union does take place, and that, when this is severed, the parts remain unchanged, as far as bony union is concerned.

The reader can thus see the importance of not disturbing the limb by any handling whatever, in a case where there is the least reason to suspect an intra-capsular fracture.

The patient himself should not expect that justice could only be done to his case, and a proper amount of professional attention shown, by what is known as a thorough examination.

Should the injury be less in amount than a fracture, the plan of non-interference is equally applicable; and, as we advise in the case of the more serious injury, fracture, it offers the best chance of a favorable result. In either case, every thing is to be gained by quietude; and the gradual restoration of the fractured parts should be effected by the proper appliances, rather than their sudden adjustment by manual force.

The following items were furnished by a gentleman of high standing in the profession as a surgeon, and whose good judgment was evinced in his decision not again to interfere in a similar case, so far as to produce displacement, after witnessing the shortening that took place during his manipulations in the case he mentions below.

He says: "I have several times seen cases of injury to the hip in which there was slight but perceptible shortening, no crepitus, the foot turned outward with inability to turn it inward, the trochanter moving upon a radius of usual length, &c.

"In one case the patient attempted to rise from bed at the end of three weeks, when she felt the sudden separation of the neck of the femur, and immediately there was two inches shortening, with crepitus, and all the well-marked signs of fracture of the neck. She has now an ununited fracture."

"In another case the separation occurred during prolonged efforts to determine the nature of the injury.

"In *two others recovery took place*, the patients being treated as if fracture existed. A slight effort was made in these cases to detect crepitus, care being taken not to displace the fragments by forced manipulation."

We will mention that the two cases of recovery were treated by *continued elastic extension*, with a bandage about the pelvis and over the trochanter to steady and support the fractured parts, also to aid in maintaining apposition.

TREATMENT.

From what has already been said, it is evident that the utmost care should be taken in raising a person from the fallen position, where there is reason to suspect the occurrence of this injury.

We should direct a strong man to so grasp both femurs above the knees as to bring them firmly though gently together, in such manner as to make the uninjured limb steady and support the injured one, while another man raises the patient by placing his arms under the shoulders of the patient.

In this manner the patient may be lifted and placed upon a couch or mattress, to be removed.

Being so placed, the lower limbs should be secured together for support and steadiness, and, in addition, a bandage or handkerchief should be looped about the ankle of the injured limb, and the ends tied at such length that, when passed over the sound foot like a stirrup, the patient can make such extension himself with his sound limb as shall bring the injured limb into a comfortable position, until such time as other apparatus can be substituted.

The patient having arrived where he is to remain permanently during the treatment, adhesive straps should be applied, and extension of the limb made by means of a weight, as recommended in the treatment of morbus coxarius. The weight should be sufficient, that, after a few hours' application, it will suffice to bring the limb down to its full length.

Four or six pounds for the first few hours, and then increased to eight or ten pounds, will probably do it. The limb requires to be watched, to maintain it at its natural length and in proper position.

It will be observed that we have not advised any manipulation of the limb to ascertain the nature of the injury, whether there is a fracture or simply a sprain with contusion.

This precaution, as before intimated, gives to the patient the best chance of a favorable termination, which, in cases of fracture, is of course union by ossification; and in case there should turn out to be only sprain or contusion, the same plan of treatment is the one best calculated to benefit the patient.

If, after a few days, the patient feels a conscious ability to move his limb and to exercise it, the dressings may be removed. The patient and the surgeon have both been on the safe side. On the other hand, if it turns out that fracture has occurred, the advantages likely to accrue of bony union, which has been secured by this timely caution, can scarcely be overestimated.

If not productive of pain, the patient can be carefully raised to a sitting posture a portion of the time, to relieve the discomfort of confinement. And again, a little change of position of this kind might serve to bring the divided bone into exact apposition, if it had not been before, while at the same time it would not displace the fragments, if the parts were before in their natural relative positions.

The great care of the surgeon should be, from the commencement, not to break up any periosteal or ligamentous union that may exist between the divided parts; for it is to this connection and at this point we are to look for ossific union to commence. If we can secure ossific union at one point, however small, then we may reasonably look for extension of the same, and an eventual firm union.

After partial union has taken place, the splint and apparatus for extension which we use in cases of morbus coxarius can be applied, and the patient allowed to exercise upon crutches.

OLD DISLOCATIONS.

FORMERLY, when the distinctive term "old" was applied to luxations, it meant those of a few weeks, or, at most, a few months' standing. In future, the time may be extended to years.

Heretofore the reduction has been by force, endangering the rupture of important blood-vessels and nerves, and not unfrequently the life of the patient was sacrificed by the operation. The process was not dissimilar in principle to that employed by a European surgeon, with his bone-crushing machine, for overcoming true or false anchylosis of joints, where he would place a limb, and, by an immense outlay of power, crush a joint, and thus be enabled to bring a limb into some semblance of the normal position. If the same result had been produced by accident, it would be considered a most serious injury—one endangering life. How can it be any less so when done deliberately, and as a remedial measure?

The sequel proved the operation to be equally dangerous; and not only so, but a portion of those who survived were not benefited by it.

At the present time, by means of the principle we have promulgated, that a ligament, or other soft tissue, can be elongated to any desirable extent by the use of *continued elastic extension*, we have it within our power to reduce almost any dislocation, without reference to the length of time it has been luxated, and it can be done not only without pain or suffering, but without the slightest danger to life, and with almost a certainty of a perfect restoration of the joint to all its functions.

This is not a process by which one joint only can be reduced, but a *principle* equally applicable to all—a mode of preparing the parts by which we can not only reduce a luxation successfully, but can do it *without violence.*

It is impossible to estimate the value of this process, as it reaches successfully a class of cases that heretofore were hopeless. Like most discoveries of great moment, it is so simple that the only wonder is that every surgeon had not recognized it. Both this, and our discovery that muscular contraction performed an important part in the destruction of joints, and was the prime caüse of the extreme suffering experienced in most diseases of those parts, seemed too palpable to be overlooked, and only excite our surprise that they so long remained undiscovered. We can frankly say that, for years after the truth began to dawn upon us, we were more disposed to doubt and disbelieve the evidence, than to suppose that the profession had so long failed to discover what apparently was so evident. We fear this same state of mind has too often led those comparatively young in the profession to discard glimpses of light, because, if true, it appeared too plain not to have been before recognized by the great body of eminent men who had preceded them.

By this plan of elongating the soft tissues, all dislocations, whether recent or of *many years* standing; all fractures, all deformities that are dependent upon the soft tissues, are entirely within our control. These soft tissues can be *elongated* or *shortened* as we please. Ligaments that are inextensible, that are designedly made unyielding, are no exceptions to this rule. The future alone, as the principle is applied to the various misfortunes of our race, can fully develop and make evident the importance of this discovery. We have reduced dislocated hips at all periods of time, from the recent up to that of fourteen years' standing, and, in the latter case, restored a club-foot on the same limb at the same time.

This mode of preparing a joint for reduction brings into their normal condition, as to length, position, &c., all the parts connected with it. This natural relation of the surroundings materially aids in retaining the bone in its place after reduction, as all the muscles, acting equally upon all sides, now serve to retain it; whereas, by the former mode of forcible reduction, those muscles that were put upon the stretch tended constantly to withdraw it, and were not counteracted by those upon the opposite side; for they, by reason of their having been long kept tense, had become elongated.

We think this has been the cause of the difficulty surgeons have experienced in retaining a joint in its place, after they have succeeded in reducing it. They supposed the cavities were filled up or obliterated, and therefore the bone would not remain in its place. This may be partially true. The cavity undoubtedly undergoes changes when not used for a long time for its legitimate purposes; yet this is not sufficient to account for the readiness with which the joint will be again luxated. If the joint is equally supported, or drawn upon equally on all sides, what except violence will displace it? It is at rest, neither drawn to one side nor the other; therefore there is no force operating to remove it from the cavity.

By the old plan of reducing the bone by violence, the muscles and ligaments on one side were drawn very tense, while upon the other they were as lax in proportion, their points of insertion having been moved toward their points of origin, as far in proportion as their place of insertion had changed by the changed locality of the head. The only wonder is that it would remain any length of time —that it was not immediately drawn out again by the force of those muscles that were put upon the stretch.

It should be remembered that, during this process of ours of preparing a joint for reduction, the muscles, ligaments, and soft tissues that were drawn tense or elongated during the period of luxation, are gradually becoming shortened by the same process, and at the same time that the others are being elongated, and that they apparently keep pace with each other, so that eventually the head comes to the cavity with the same state of tensity of the surroundings that existed before the joint was luxated. With this preparation, there is theoretically no more danger of a renewal of the luxation from the action of the muscles and other soft tissues than if no luxation had taken place.

It will be immediately recognized that all danger of injury to the blood-vessels or nerves by this mode of preparing the parts will be avoided, as they elongate with the other soft tissues. This is of the highest importance; for it is well known that, in old dislocations of the humerus, attempts at reduction have in some instances been most disastrous.

So far as the certainty of a reduction is affected, a luxation of twenty years' standing is upon the same footing as one of twenty days. The principal difference is in the length of time requisite to accomplish it. We do not say there is the same certainty of the joints being equally useful in both cases, only that each can with certainty be restored to its original locality.

In making extension for the reduction of some dislocations, as of the hip-joint, which, it is known, may occur in various directions, the bone may be used as a lever; but the bone should not be so used, since it will, if it do nothing worse, elongate parts which perhaps do not require it.

This difficulty is more liable to occur in joint diseases and deformities, than in luxation. The extension should be made in that line which acts most directly upon those parts that are the most tense when the limb is moved in the direction of the joint, consequently they require to be elongated most. This should be watched during the progress, so that, in the end, when the head of the bone is restored to the cavity, all of the surroundings of the joint will be uniformly tense

It would require a volume to give minute directions for the treatment of every luxation that might take place. We trust the general principle has been so fully explained that any ingenious surgeon can apply it in any given case.

It has been our endeavor to arrive at first principles; if these are well understood, the application is comparatively easy.

CONGENITAL DISLOCATIONS.

Several theories have been advanced from time to time, intended to account for the occurrence of dislocations in utero. While we have no new hypothesis as to the cause of these abnormal conditions to advocate, we have some remarkable cases to offer, differing from any upon which theories have been heretofore predicated, and we propose to devote a few pages upon this subject, for the purpose also of presenting to the profession an abstract of the principal features conceded to pertain to such cases, and more especially to offer certain modifications in the plan and apparatus required, so simplified as to constitute, in our judgment, a decided improvement in their treatment.

Among the hypotheses bearing on this subject which have had their supporters, may be mentioned *external violence acting upon the child while in utero.* The possibility of the limbs of a child contained within the organ of gestation being dislocated by falls, blows, or compression upon the abdominal walls of the mother, was allowed by Hippocrates, and it has also been conceded that these malformations may be due to a hereditary transmission. It has been claimed, in opposition to the theory of external violence producing dislocations in utero, that certain dislocations, as for instance at the hip-joint, from traumatic causes, are exceedingly rare in early life, and that any force originating externally of a mechanical kind, and of sufficient energy to act upon the fœtus in utero, would be more apt to produce fracture than dislocation.

The hypothesis of Dupuytren is based upon the supposition of an *original vice of conformation, depending upon a defect in the constitution of the germ*, and he states that simultaneous displacement of both femurs is observed in most of the individuals so affected, and also that females are more prone to this congenital defect than males. But, altogether, his hypothesis is considered unsatisfactory, and to have no support from physiological facts.

M. Breschet considers these dislocations to result from an *arrest of development at the cotyloid cavity.*

M. Cruveilhier, however, in his Pathological Anatomy, does not corroborate this idea, nor is this view sufficient to explain the occurrence of these displacements in other joints.

Among the hypotheses of older date, and which has more recently been advocated by M. Parise, may be mentioned that which ascribes these malpositions to *certain articular diseases occurring in the fœtus during intra-uterine life.*

The articular diseases referred to are those which cause an effusion of fluid into the cavity of the joint. But the fact, that congenital dislocations at the hip-joint have been met with in the fœtus in which there was not any superabundant secretion in the joint, shows that this theory is not infallible.

The more modern and probably correct theory, inasmuch as it may account for a larger number of cases than any other upon this subject, is that advanced in an able Monograph upon "*Congenital Dislocations of the Femur*," by our esteemed friend, Doctor J. M. Carnochan, of this city, who attributes these abnormities to a "spasmodic retraction of the muscular tissue," and refers these retractions, upon which he claims congenital dislocations of the head of the femur from the cotyloid cavity depend, to "*a per-*

verted condition of the excito-motor apparatus of the medulla spinalis, and more especially of that portion of it which is in direct relation with the reflex-motor nervous fibers distributed to the pelvi-femoral muscles surrounding, and in connection with, the ilio-femoral articulation." But even this does not account for all the cases that occur, and it is probable that different cases are produced by different causes.

The joints most liable to this variety of luxation are the hip, wrist, and shoulder; but we have now under treatment a case, where the hip and knee were both dislocated at birth, the legs being doubled over in front at the knee-joint, so that the dorsum of the foot rested in contact with the pubis.

It may happen that these dislocations occur in the shoulder and wrist, or in one of these joints and the hip of the same subject, or may occur singly, or in some cases there may be double dislocation, both femurs, for instance, being luxated. Both sexes are subject to this malposition, but females have been found more liable to it than males, in the proportion of at least three to one. These dislocations are conceded to be occasionally hereditary, notwithstanding the conflicting hypotheses entertained regarding their cause.

M. Dupuytren relates an illustrative case of a family living in Nantes, France, several members of which were afflicted with congenital dislocations of the femur, and gives, as follows, the history of the oldest member of this family, a female, at that time eighty years of age, named Marguerite Gardas, and which history was corroborated.

"Marguerite Gardas is a large robust woman, in whom the malposition was not prominently marked until she was thirty years of age, and its symptoms are those of a spontaneous luxation of the femur.

"Two of her aunts on the maternal side, who died at seventy years of age, had been afflicted with lameness from their earliest attempts at walking, and they were in the habit of stating that they had always been lame.

"Their hips were elevated, protuberant, and abruptly prominent, and they walked with their elbows projecting backward, and in a waddling or hobbling manner.

"Marguerite's father had had a sister, lame upon the right side from birth, who died at eighty years of age. Another sister, who was well formed, gave birth to a female child, which had shortening of the right inferior extremity.

"With Marguerite, the affected limb is one-fourth less in diameter and considerably shorter than the healthy member.

"She has had a daughter, who has congenital shortening of the right inferior limb of about three inches, although her father is a foreigner, healthy and well formed. This girl is also married to a man of healthy conformation, but whose father had a congenital luxation of both femurs. She has had four children, two of whom have had congenital dislocation of the femur. The one is a young woman twenty-three years of age, and has luxation of both femurs, the heads of which are situated in the external iliac fossa; the other is a young man twenty-one years of age, who has a congenital dislocation of the left femur, which limb is five inches shorter than the other; the head of the bone has ascended upward and backward: the trochanter major projects forward and outward, and the toes are turned inward; the two limbs are equally well developed."

SYMPTOMS.

The symptoms of congenital dislocations vary according to the time of life of the patient at which they are brought under notice. In the infant, the signs are not so definitely marked as after the patient has walked, and, by carrying the superincumbent weight of the body during progression, has forced the head of the femur more and more upward and backward upon the dorsum of the ilium.

The changes produced by these malformations can be better observed by inspection when the patient is entirely stripped of clothing, when manual and visual examination will enable us to trace the altered relations of the component parts of the ilio-femoral articulation, as well as the functional disturbance occurring at the joint itself, as regards its various movements.

The deformity is often almost symmetrical, when the dislocation of the femur upon the ilium exists on both sides.

The lower limbs may have the same development and length, but the body being normally formed, there is seen to exist a marked disproportion between the relative size and height of the trunk, and the length of the lower extremities.

Cases of double luxation of the femur upon the ilium, in an adult person, present, when viewed in the erect posture, curvature forward of the lumbar region, and convexity of the anterior wall of the abdomen; the pubic region seems to be tilted forward and downward, while the lower part of the trunk appears to be sunk down, which is in fact the case, between the upper portion of the thighs, which gives to the arms the semblance of being relatively too long as compared with the length of the legs, the extremities of the fingers being in some cases on a level with the patella.

The great trochanter on each side is unnaturally prominent, and, being situated considerably higher and much nearer the crests of the ilia, forms, with the retracted muscles surrounding, by crowding them upward, an unusual eminence, somewhat rounded on each side at the upper and lateral part of the hip, which leaves the lower and posterior part of the nates flatter than natural.

The traction upon the soft tissues, by the heads of the femurs, has a tendency to denude the tuberosities of the ischia of muscular tissue, leaving them covered only by the integuments, and also giving to the inguinal fold a more oblique direction. The two limbs may retain nearly their natural direction, or may incline obliquely inward at the knees, forming more or less an angular deviation from a vertical line. In cases of this kind, the patient can usually, when standing erect, rest upon the entire sole of the foot, as in this passive state the muscles surrounding the hip are relaxed, and allow the femurs to ascend to their utmost height upon the iliac bones: but this ascent of the heads of the femurs upon the dorsal aspect of the ilia puts the psoas magnus and iliacus internus of either side upon the stretch, and tends to draw forward the lumbar and lower dorsal vertebræ, and thus aid in producing the abnormal convexity of the anterior wall of the abdomen, and the excurvation of the loins. As the posture of the individual varies, the feet will be turned outward or inward, as pertains to such dislocations of traumatic origin.

When the patient is placed horizontally on the back, most of the symptoms observed in the erect posture disappear; the superincumbent weight of the trunk being removed, the muscles surrounding the thighs allow the femurs to descend to a nearly natural direction, and the psoas and internal iliac muscles being relaxed or relieved of traction, the curvature of the lumbar vertebræ and the convexity of the anterior abdominal parietes become almost entirely effaced. This constitutes an important element in the differential diagnosis between the congenital and traumatic dislocations at the hip-joint.

Manual examination of the parts is unattended with pain, or, if pain is present, it is much less than in the traumatic form of dislocation. There is also much less, if any, swelling; the head of the bone can be felt in its abnormal position; motion is either much impeded or too free. Extension and counter-extetnion in young subjects generally readily restore the displaced articular surfaces in apposition; but they are as easily returned upon the dorsum ilii by retraction of the muscles, as soon as the extending force is discontinued, on account of the head of the femur meeting with insufficient resistance at the brim of the acetabulum. In old subjects, reduction is always proportionally difficult, especially where the head of the femur has escaped from the natural capsule in which it was originally inclosed, and a new socket has been formed, by adventitious growths, in a similar manner as is liable to occur in traumatic dislocations in this region.

In young subjects, where the diagnosis is obscure, it may be rendered more certain by flexing the thigh upon the pelvis with slight adduction, and, by tracing a line from the anterior superior spinous process of the ilium to the most prominent point of the tuberosity of the ischium, this line will, in the normal position of the head of the femur, nearly correspond in its course with the summit of the trochanter major; whereas, if the head of the femur be displaced upward and outward, the line will pass more toward the base of the trochanter, according to the height to which the femur has ascended.

Efforts at locomotion will show the extent of functional derangements of the joints, either by the limited or too free motions which the joints may be made to perform; and in adult persons affected with double dislocations of the femurs, the peculiarities of the gait in walking and other uses of the legs are such as do not pertain to other varieties of lameness, resulting from other derangements at the hip-joint.

In consequence of the mobility of the heads of the femurs, and the movements they undergo, in walking, of alternate elevation and depression, and the strain which is put upon the psoas and internal iliac muscles, first on one side and then on the other, as the weight of the body is shifted from one leg to the other, a peculiar lameness is produced, which has been compared to the hobbling gait of the duck; and these movements are often accompanied by a crepitating sound, loud enough to be heard at a considerable distance. This ungraceful gait, resulting from lack of support of the femurs at their natural place of apposition, the cotyloid cavities, and their consequent ascent upon the dorsa of the ilia, is less observed during the acts of dancing, running, or other quick movements, probably on account of the more energetic contraction and compression of the surrounding muscles exerting a restraining influence upon the heads of the femurs, holding them in a more fixed position, and thus preventing their oscillations. Patients, however, troubled by this affection cannot undergo much exercise without inducing fatigue, in consequence of the strain upon the muscles in their changed position and perverted action, the friction of the displaced heads of the femurs upon the ilia, and the constant efforts kept up in balancing the body upon an axis so materially deviating from the centre. The limbs themselves admit of extension and adduction with facility, but abduction is quite limited. Flexion can be effected with great ease and freedom, cases having been known in which the limb could be made to touch the anterior part of the shoulder.

In congenital dislocation of the femur upon the ilium on one side only, the general characteristics in relation thereto are similar to those which obtain in the double luxation.

There is more or less lateral curvature of the spine, inclining toward the affected side of the pelvis, which latter is also depressed below the level of the healthy side: and the same appearances exist on the affected side as to the protuberance caused by the head of the displaced bone crowding upward the muscles, the modification of the fold between the nates and thigh, the oblique direction of the

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inguinal fold, and, in the female, more or less deflexion of the border of the vulva, which is drawn upward and outward on the side corresponding to the luxated femur. The limb is shortened from a few lines to two or three inches, according as the femur has mounted along the dorsum ilii, and is generally not so well developed as the sound one, the muscles being smaller and softer.

By placing the two anterior superior spinous processes of the ilia upon a level, the internal malleolus of the affected limb will be found situated higher than the one upon the opposite side, and will indicate the extent of the shortening. The affected limb is more or less bent at the knee, with a tendency to cross the sound one, while the foot is in a state of extension and rests upon the toes. This varies according to the length of the neck and head. The more marked, the more perfect they are.

The head of the femur, in its natural position, can be felt by grasping the upper and outer part of the thigh in such manner that the thumb may be placed transversely in the fold of the groin, a little external to the point where the pulsation of the femoral artery can be felt, when, if a movement of rotation be given to the head of the femur in its natural socket, it will be felt to roll under the thumb and fingers; the absence of this sensation of a rounded body moving under the fingers may be taken as a certain sign of displacement.

The same manual examination in cases of single luxation applies as in cases of double displacement.

The lateral inflexion of the spine in the single cases becomes less marked, or entirely disappears, if the patient be placed upon his back, in which position the limb can also be pushed upward toward the crest of the ilium, or pulled downward so as to be of the same length as the sound limb.

The diagnostic sign mentioned in speaking of the double variety of this luxation, viz., drawing a line from the anterior superior spinous process of the ilium to the most prominent point of the tuberosity of the ischium, having flexed the thigh upon the pelvis and slightly adducted it, and observing whether the summit of the trochanter major is found to pass superiorly to this line, in which event the dislocation of the head of the femur may be almost to a certainty pronounced to have occurred, is particularly useful in detecting the existence of the single dislocation, which is more difficult to diagnose than the double form.

DIAGNOSIS.

Traumatic dislocation of the femur upon the dorsum of the ilium from external violence is the affection most liable to be confounded with the congenital form of this luxation. Strumous synovitis of the hip-joint, attended by spontaneous dislocation, from destruction of the articulation, might also be mistaken for the displacement in question. But an examination of the characteristics will enable us to arrive at a correct solution of the case.

In the congenital dislocation of the head of the femur upon the external iliac fossa, the history of the case will show that lameness manifested itself from the earliest period of infancy, and upon the first attempts to walk; that the general health of the patient was good; that there was absence of primary inflammatory symptoms of the hip-joint; that there was no injury sustained to which to attribute the lameness; that the hobbling gait existed during efforts to walk, from the first attempts at progression; that the prominent convexity of the anterior wall of the abdomen and the concavity of the lumbar region existed at the commencement; that there is generally symmetrical dislocation on both sides; that these appearances, to a great extent, disappear on the patient being placed on the back; that the head of the femur may be made to ascend and descend upon the dorsum of the ilium through a space of from two to three inches, the upper margin of the great trochanter becoming nearly horizontal with the crest of the ilium, or appearing correspondingly below the same point, according as the limb is pushed upward or pulled downward; that these movements are unattended with pain, and will, when compared with the lessened mobility of the joint in recent cases of this dislocation produced by external violence, the shortening of the limb, the inversion of the toes, and more flattened appearance of the hip; or, in cases of strumous disease of this articulation, in which there can be traced an inflammatory condition of the hip-joint, with accompanying fever, pain, &c.; the formation of abscesses, the existence of fistulæ, and, in the latter stage, the ulceration and disappearance of the head and neck of the bone, the trochanter alone being left resting in the acetabulum or upon the dorsum ilii; and the frequent occurrence of anchylosis, and resulting flat aspect of the hip—form, collectively, an assemblage of facts which cannot but enable the surgeon to come to a correct conclusion, and discriminate with certainty which of the three conditions he is called upon to attend.

This congenital dislocation of the head of the femur upward and outward upon the ilium has been confounded with strumous disease of the hip-joint more often than any of the other affections incident to the ilio-femoral articulation.

The lameness in the strumous form of disease does not become apparent until the close of the first stage of the disease, and is unaccompanied by any perceptible shortening of the limb, and considerable pain is felt when any motion is made which causes increased pressure of the head of the bone against the acetabulum; and this pain is mostly referred to the region of the knee of the affected side; whereas, in congenital luxation, movements of the joint are effected with great ease, and unattended with pain; nor does the patient shrink from manipulation of the parts, as in the strumous disease of the joint.

The health of the patient always suffers in strumous disease of the joint, but does not in cases of congenital luxation; besides, it is extremely rare for the strumous disease to occur in both hip-joints simultaneously; but this is quite common in the congenital form under consideration.

The differential diagnosis may be aided by reference to our article on *Strumous Synovitis.*

There are other affections mentioned by authors as liable to be confounded with congenital dislocation of the femur, a familiarity with which will aid the surgeon in his differential diagnosis.

M. Guérin mentions a class of congenital deformities of the hip, which he calls pseudo-luxations, because they are incomplete, but simulate the complete form. Two varieties of this deceptive form may occur, one simulating dislocation of the femur backward and outward, the other, dislocation downward and forward. The deformity consists in a permanent abnormal direction of the limb, and is attributed to morbid muscular retraction, exerted, however, in an insufficient degree to produce complete disarticulation of the head of the femur. Other alterations in the head and neck of the thigh bone, and of the acetabulum, are mentioned, such as an abnormal enlargement of the cotyloid cavity, allowing unusual latitude of motion to the head of the femur; an exostosis arising from the bottom of the acetabulum, and crowding the head of the femur beyond its natural position; a malformation of the ilio-articulating extremity of the femur, in which the head and neck are partially atrophied, and apparently merged into the trochanter major which rises above them; and an atrophy involving one-half of the pelvis as well as the corresponding limb.

It has been observed by Sir B. Brodie that the femur, tibia, and fibula of one lower extremity may be shorter than those of the other limb, from congenital conformation.

Interstitial absorption of the neck of the femur is liable in old age, and causes shortening of the lower limbs, and also predisposes to fracture of the neck of the femur.

Pelvic deformities, of a rachitic origin, may also occur, giving rise to malpositions of the articulation; and Delpech mentions an atrophied state of the halves of the sacrum and of the ilium, as causing lameness. Various other anomalies, causing lameness in walking, may simulate more or less the congenital dislocation of the head of the femur.

PATHOLOGY.

The morbid appearances to be met with in post-mortem examinations of this luxation vary according to the age of the patient. The acetabulum is generally deficient, and in some cases almost obliterated, being filled up with cellulo-osseous material, leaving a small, irregular, osseous prominence, devoid of cartilage and synovial membrane.

The head of the femur is altered from want of vascular nutrition, its normal relations with the articular cartilages, the round ligament and synovial membrane being interrupted, and becomes flattened at its antero-internal aspect, particularly where it impinges upon the osseous tissue of the ilium, upon the dorsal surface of which it rests in a sort of superficial fossa. The neck of the femur is found small, short, and stunted, and so changed, in the direction of its bearing to the axis of the femur, as to bring the head of the bone more on a level with the trochanter major. The osseous tissue of the head of the femur is found more brittle, and of less firmness than natural, from perverted nutrition, and where the case is of long standing, the head and neck of the bone are found to have almost entirely disappeared, leaving the ligamentous attachments between the pelvis and trochanter.

There can be no doubt as to the degeneration and atrophy of these parts being due to interrupted circulation, arising from the displacement, causing torsion and strangulation, or, at least, stretching of the nutrient vessels to such an extent as to interrupt the supply to the osseous tissue.

In consequence of the ascent of the head of the femur upon the dorsum of the ilium, the capsular ligament and the ligamentum teres are found elongated beyond their normal length, and the round ligament participates also in the tension.

These may remain intact for years, but eventually, from continued friction and pressure, absorption takes place, and they give way, allowing the head of the femur to escape from its cavity, and to come in direct contact with the osseous structure of the dorsum of the ilium; and it has been observed that these soft tissues may change and coalesce to form a strong ligamentous band attached between the margins of the acetabulum and the upper portion of the femur. Nature often makes reparatory efforts, after the escape of the head of the femur from its natural capsule, to form a receptacle for it upon the surface where it has become lodged, and also to form a new capsular ligament, which is generally attached to the dorsum and surrounding portion of the ilium in contact with the head of the femur, and, at the other extremity, to the margin and perforation of the old capsule through which the head escaped, and radiating fibres form and coalesce to strengthen the provisional capsule.

The new socket will generally amount to simply a glenoid depression upon the dorsum of the ilium, but it may occur, as after traumatic dislocations, that new osseous matter is thrown out upon the ilium, which will, to some extent, form a cup-like imitation of the original cavity. As nature progresses, this socket may present a smooth articulating surface, with a lining somewhat analogous to synovial membrane; or, from age and friction, it may become polished. When the osseous surfaces in contact are not protected by the intervention of any soft tissue, they produce a crepitating sound as they move upon each other.

The surrounding muscles present changes from the normal condition of health, according to the age of the patient and habits of life; they may be either atrophied, hypertrophied, or degenerated into a yellowish, fatty, fibrous tissue, which result from perverted action of the pelvi-femoral muscles, some of them being so placed, in consequence of the luxation of the head of the femur, as seldom to be brought into a state of action, while others have to perform additional work; this increased exercise to certain muscles, as the gluteus maximus and gracilis, induces a hypertrophic state; still more energetic traction long continued is apt to induce fibrous degeneration, as is seen in the conjoined tendons of the psoas magnus and iliacus internus, and often of the gluteus minimus; while relaxation and want of exercise of the gluteus medius, and such other of the pelvi-trochanteric muscles as have had their points of origin and insertion approximated by the displacement of the head of the femur, are liable to fatty degeneration, in which latter case their action, or power to act, is very limited, if not entirely annihilated.

The arteries in these cases are sinuous and serpentine, and are more or less contracted in their calibre, while the veins are more direct in their course, and larger than normal in their diameters. The nerves are disposed in a direct course for distribution in the muscular tissues, and are smaller than natural. Extension of the limb for the purpose of effecting the reduction would, therefore, be apt to stretch the nerves and cause some pain, but would not, on account of the flexuous course of the arteries, particularly affect them.

The stretching to which the arteries of the ligamentum teres must be subjected, in the early period of the luxation, undoubtedly lessens their calibre, producing compression and arrest of the flow of blood to nourish the head of the femur, which is supplied through this medium, and also depends indirectly upon the periosteum and internal medullary membrane. In consequence of the arteries in the vicinity of the dislocation not being of their normal size, the medullary membrane is not supplied sufficiently for the interior nutrition of the bone, while, from the same inadequate supply to the periosteum, the more superficial parts of the bone also suffer from want of nourishment, and hence the liability to curvature or fractures, from the inordinate muscular traction to which some of the muscles, in cases of congenital dislocations, subject the femur, in certain positions in which their direction is perverted.

Malformation of the pelvis is an invariable accompaniment of this form of congenital dislocations, and, in the female, may give rise to serious complications in cases of parturition, inducing the necessity of premature labor or the use of instruments.

We have given very fully in the foregoing pages the opinions of writers upon this subject. What follows will be a statement of our own views, in the form of a commentary on some portions. The treatment is entirely our own.

We cannot assent to the belief that external violence, applied to the child in utero, would be more apt to produce fracture than dislocation. On the contrary, we can hardly conceive of a fracture in utero of the long bones, for the same reason that it is so rare in *extra*-uterine life, viz., that the bones are so very soft and pliable, they would bend rather than break upon the application of force; the direction of their axis in utero being at a very acute angle with the trunk, they would be apt to slip past the socket, particularly if such external force were applied upon the femur when in this flexed position upon the abdomen of the child, which it usually maintains during gestation. Again, the muscles, in this closely flexed position of the femur, are so arranged that their action would aid any external force applied in the direction of the shaft of the bone, and it is not unfrequent that the knees of the fœtus are the most prominent presenting part, when the hand is applied upon the abdomen of the mother over the uterus.

POSITION OF THE BODY.

The incurvation of the lumbar region, the corresponding projecting of the shoulders and head backward, the tilting forward of the pelvis, we can not admit as being due to the strain upon the psoas magnus and iliacus internus muscles.

This position of the body, when *erect*, is simply a necessity on the part of the individual to support the centre of gravity, as illustrated in cut on page 65. It will be seen that almost the entire trunk is in front of its pelvic support; consequently, the centre of gravity falls in front of the base represented by the feet. With this position of the femurs upon the pelvis, the only way for the person to stand is to throw the head and shoulders back until they balance that portion of the body that is in front of the femurs.

That this position of the spine, and the tilting of the pelvis, is for the purpose of sustaining, when erect, the centre of gravity, is evident from the fact that, if the patient is placed upon the back, and the limbs thrust up to the same point they are when standing, we get no alteration of the pelvis or spine, which alteration would necessarily follow if the strain upon the psoas and iliacus muscles were the cause. The supposition of writers, that the curving of the spine and the tilting of the pelvis were relieved when in the prone position, because the femurs were allowed to come down until all strain upon their muscles was removed, is not correct. The strong glutei muscles hold the femur up, and must be overcome before the other muscles can be relaxed. The thrusting of them up with any amount of force, when the body is prone, will not produce the deformity.

POSITION OF THE HEAD OF THE FEMUR.

The directions given by authors for finding the head of the bone in its abnormal position, cannot be relied upon, for, in many cases, even the neck is but slightly developed, or, if developed, was afterward absorbed, so that we must depend upon other evidence.

The position of the trochanter, in reference to the superior spinous process of the ilium, is sufficient to enable the surgeon to decide whether there is displacement. The patient should lie flat upon the back, that the position of the pelvis may be correct. When in this position, a perpendicular from this process will pass above the trochanter (when in its normal position), in a child under five years, from one-half to one inch, varying therefrom according to the size of the child; the femur should also stand in a line with the axis of the body, antero-posteriorly. If but one limb is displaced, we have the other to compare it with. The alteration will be most apparent when the patient is supporting his weight upon the feet, as this position shows not only the displacement at the pelvis, but its effect in changing the figure, in order that the centre of gravity may be supported. A corroborative test will be to rotate the limb, and thereby ascertain the point around which the limb revolves.

ADDUCTION AS A SIGN OF DISPLACEMENT.

The adduction of the limb, as a sign of displacement, depends upon the fact of whether the head and neck are in a normal condition of development. If they are normal, we shall have the same position of the limb as in traumatic luxation; the knee will be in contact with the other limb above the joint, the foot at right angles with its fellow, and, when compared with the sound limb, will appear from two to four inches shorter. If the head and neck are in miniature, or absorbed, there will be but little if any adduction, but the whole limb will stand much closer to the body, and the inside of the thigh may pass by the median line. When compared with its fellow, the hip will be found much less prominent.

In walking, if the head and neck are of normal size, the heel will be drawn up, the weight resting upon the toes, and when in this position, and the body is moved forward, the foot rolls upon its outer edge, and has all the appearance of a club-foot. In a few years it becomes fixed, and the muscles are lost to the will, as in club-feet.

THE COTYLOID CAVITY.

We are inclined to the belief, that in most cases of congenital dislocation of the hip, the bony portion of the cotyloid cavity is fully developed, but the fibro-cartilaginous portion is not, or, if formed, is absorbed as useless. The degree of development of the fibro-cartilage depends very much upon the time at which the luxation took place; if near the time of birth, it would be quite perfect.

PHYSIOLOGICAL EFFECTS OF REDUCTION.

We would remark in this connection that, judging from the efforts of nature to retain the functions of a joint, although the several parts comprising it are in new and abnormal position, we are encouraged to believe that, when the imperfect (by reason of arrest of development) head and neck of the femur are placed in what may exist of an acetabulum, and retained there *unremittingly*, the functions of a joint being kept up and stimulated by passive exercise of the parts, that, after we have done this much, the original law of development will come to our aid, and that the sound parts will be partially if not wholly restored, or at least will keep pace with the future growth of the body. We have better reason to anticipate such a result, than other changes and efforts at reparation that we observe to take place in many cases of injury.

The younger the subject at the time of reduction, the greater the probabilities of a perfect recovery. The mere restoration of parts to their natural position will not be sufficient; they must not only be restored, but passive motion must be assiduously performed, while at the same time it should not tend to displacement. As much depends upon our bringing into action the law of functional growth as the law of primary development. There have been instances where all the parts of a joint, even to bone, have been formed where none existed previously.

PATHOLOGICAL CHANGES DURING FŒTAL LIFE.

Authors speak of the pathological changes of the parts in and about a joint dislocated during fœtal life. It is difficult to decide whether any of the changes mentioned existed at the period of the luxation. It is most probable that the major part are the *result* of the dislocation; they follow from the abnormal position and derangement of the function of the joint. Some muscles become quite useless, therefore degenerate; others are placed in so abnormal a position, yet retaining their function, that corresponding changes necessarily take place in them also. The head of the bone, while retained in the capsule, yet removed from the cotyloid cavity, will constantly press upon the capsular ligament, and this pressure will produce absorption; again, the function of the limb may be so much impaired that growth will be interrupted.

THE CAUSE OF ITS GREATER FREQUENCY IN FEMALES.

This form of dislocation is said to occur much more frequently in females than in males. It would at first appear that no theory could satisfactorily account for this; but when we take into consideration the fact that the pelvis in females is larger in proportion than that of males, it follows consequently, that the femur can be placed at a greater angle with the cotyloid cavity—an angle that would allow the head to pass out more readily than in the male, if force were applied in the right direction at the time. We think this fact will satisfactorily account for females being more subject to congenital luxation of the femur than males.

That congenital luxation should occur so much more frequently in the hip than any other joint, would rather favor the supposition that it was caused by some violence, or some spastic contraction of the muscles, while the limb was closely flexed upon the abdomen.

We have had one case of luxation of both hips, in a boy six years old, occurring after paralysis from teething. The head of one femur was upward and backward, the other downward and inward into the thyroid foramen. Both were reduced by continued elastic extension.

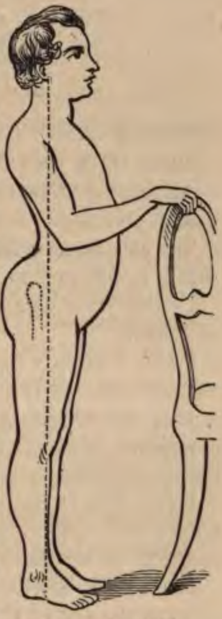
CASE 1.

Carrie B. Osborne, daughter of D. Henry Osborne, Esq., of Victor, Ontario Co., New York, aged six years, came under my observation, November 29, 1864. Her condition was as follows:—

General health good, whole body well nourished, and well formed, with the following exception: Dislocation of both femurs upon dorsum illii. Trochanters three-fourths of an inch above superior spinous process of the illia, and back of their normal position with the axis of the body, slightly adducted, but the upper portion of the femurs stand much nearer the centre of the body than natural, the inside thighs pressing upon each other, and overlapping the vulva; the femurs can be but slightly abducted; knees perfect, feet stand parallel, toes cannot be turned out as with other children. The right limb can be brought down by extension, until the neck or miniature head can be felt to pass over a ridge apparently of bone, probably the border of the bony portion of the acetabulum. Rotation of the femur gives the same sensation. The arc described by the trochanter during rotation, is small, showing that the head and neck are imperfect, or but partially developed. In drawing the limb down, the thigh is seen to recede from the vulva. This separation was very marked after the limbs had been under treatment by continued extension—the extension liberating them, and thus allowing much more freedom in thrusting them up or in drawing them down, which rendered the approach and separation of the thigh much more apparent. When up, they crowded upon each other; but, when drawn down, they were an inch asunder. A portion of this, however, was owing to elongating the soft tissue of the thigh. After extension had been applied several weeks, abduction was perfectly free; the trochanters were three-fourths of an inch below the superior spinous process of the illia.

The neck and head of the left femur appeared to be more perfectly developed than the right, yet this was much below the natural standard. In the erect position, the lumbar portion of the spine was very concave, throwing the abdomen far forward, the shoulders and upper part of the trunk were drawn back beyond their natural position with the rest of the body, the pelvis tilted forward and downward, changing the superior strait almost to a right angle with a perpendicular, while the patient was standing. The position of the femurs, in reference to the axis of the body, was most marked, leaving quite two-thirds of the antero-posterior diameter of the pelvis and abdomen in front. That this tilting of the pelvis and flexure of the spine was not owing to contraction or shortening of the psoas magnus and iliacus muscles, was evident from the fact that, when the patient was laid upon her back, with the lumbar region resting upon the couch, the limbs could be brought straight without changing the spine or pelvis.

To test this, we placed the patient, as mentioned, with one hand under the back at the lumbar region, the other upon the limbs, they being flexed, gradually pressing them down to a level with the back, without any change in the pelvis or spine, while the trochanters remained up in the same position they occupied when the patient was erect. Neither did forcing the femurs up change or tilt the pelvis or curve the spine. We think these facts prove incontrovertibly that the flexure of the spine and the tilting of the pelvis while standing, were *not* owing to contraction or shortening of the flexor muscles of the thigh. If it had been, the deformity should have been the same in the prone as in the erect position, if the femurs remained as high up.



It will be seen in the cut, that the perpendicular line divides the body in such a way, that it is evident the shoulders and chest are thrown back thus far to balance the body upon the feet. In this position, the femurs being far back upon the dorsum of the illia, and the weight of the body being sustained by the muscles that pass principally from the pelvis to the femurs —and among these muscles stand prominent, as supporters, the psoas magnus and the iliacus internus— now, as these muscles pass over the front of the pelvis and are inserted into the small trochanter, and as this trochanter is now displaced upward and backward, it is evident that the pelvis must not only be tipped forward, but, were it left unrestrained, would face backward.

This tilted position of the pelvis gives a direction to the spine forward at an angle of forty-five degrees with the limbs. As a person cannot stand and support the centre of gravity in this position, he throws the head and shoulders as far back as possible, in order to balance the body.

From the account given by the family physician, Dr. Palmer, the mother, and its nurse, it is certain that this state of the limbs at the hips, together with the condition of the knees, to be hereafter described, existed at birth. The mother states that, when the child began to walk, it was with her hands and arms raised, as a child would who felt that she was liable to fall upon her face. That the thighs were always shorter than natural, and so near together that it was with difficulty the linen could be changed; that they were not only near together, but that it was impossible to separate them.

The following letter was received by us from Dr. Palmer:

VICTOR, March 18, 1865.

DR. DAVIS:—

VERY DEAR SIR: Mr. Osborne informs me that you wished me to give you a minute history of his little girl's case from its earliest date.

The case dates so far back, that I can hardly give you a connected detail, satisfactory to you or even myself.

I either made no notes of the case, or those made are now not to be found.

I give you only from memory, and that somewhat treacherous. As to pregnancy, I recollect nothing unusual, save that Mrs. O. suffered many disagreeable feelings during gestation, which ended in premature labor, I think about the eighth month. Labor was threatening some hours before it actually commenced.

I saw Mrs. O. occasionally previous to active pains. Was then absent until a few minutes before the child was born. I think the presentation was natural, and labor rather quick.

During the last pains Mrs. O. complained of something hurting her, and the exit of the child was retarded by the abnormal position of its limbs, which was as follows, viz:—

Thighs at right angle with the body, legs flexed upon the thighs, feet firmly pressed upon the abdomen, head of the tibia drawn up and resting upon the front of the femur some inch and a half above the condyles. Before securing the cord, I made an effort to adjust the limbs, but found the resistance so great that I desisted and secured the cord, keeping the child from view of the attendants, intending to correct the deformity before seen. I then grasped the thighs with my left, and feet with the right hand, and, after a violent effort, succeeded in bringing the legs on a line with the femur; but, on letting go my hold, the legs fliped back with great velocity and force to their original place; the thighs all the while kept flexed upon the pelvis.

A repetition of effort required the same force, and the head of the tibia, instead of meeting and revolving upon the condyles of the femur, revolved upon the front of the femur, an inch or more above the condyles, so that, while extended, the tibia lapped upon the femur an inch or more.

Upon subsequent efforts, and using great force, I succeeded in bringing the heads of the tibia and femur in apposition.

When doing so, I felt the sensation of something tearing, as the limb came to a normal position. The adjustment of the limbs appeared to hurt the child very much, and even produced a convulsive action of the child's muscles.

When the child was being cleansed and dressed, I found some plates of lead, used in water-pipe, which I shaped to the limbs, bent anteriorly at an angle of some 100°, which, after padding, I placed upon the back of the limbs, and, by compresses, bandages, and ligations, bound the limbs to these splints; knees still placed forward to near a right angle, as it was impossible to keep the limbs straight without producing convulsions.

This kind of splint and dressing was used until the limbs were restored to a normal condition. As the child grew we enlarged the splint, and, every few days, I changed the angle of the splint, straightening them until we could begin to flex in the opposite direction.

This process we continued until we could bring the heels to the nates of the child, which must have occupied some six or eight months. During all this time, the thighs remained flexed upon the pelvis, and the more so the more we extended the legs. The knees were also drawn close together, and with some difficulty separated enough to cleanse and apply necessary linen.

During this treatment, I made frequent examination of the hips, back, and pelvis, and, from all I could discover, supposed that the flexure of the femur upon the pelvis was owing to the brevity of the flexor and adductor muscles, particularly the sartorius, tensor vaginæ femoris, and rectus on front, and triceps on inside of thighs.

The trochanters appeared a little prominent, and pressed upward and backward, the more so when the limbs were straightened. But, upon a little force being applied while the femurs were flexed, the trochanters would occupy their proper place; but upon every effort to straighten the thighs, the trochanters would tilt upward as far as the ligaments, which appeared relaxed, would permit. At the same time, the pelvis would tip forward and follow the femurs, bending the spine in the lumbar region, throwing the sacrum back, and bringing the spinous process of illium forward and downward.

But, from the most critical examination, I could see nothing abnormal or deficient in the mechanism of the hips, save a relaxation of the ligaments, which were continually upon the stretch, the more so when the limbs were extended.

After a few weeks' treatment at home, the nurse took the child to her own home in the neighboring town, where I saw it only occasionally, to alter and adapt the dressings to the limbs as the child grew and the limbs yielded to our efforts.

I think in less than a year the knees attained their natural position and function, and would flex only in the right direction. I think, from the first applications of dressings, the limbs were never permitted to return to their extreme flexions, nor head of the tibia to leave condyles of femur, and, as fast as was possible, brought on a line with femur and then flexed in the proper direction. This I attributed, in a great measure, to the efficiency of the nurse intrusted with the care of the child.

Subsequently, I paid little or no attention to the case for a year or two. In the mean time, the patient learned to walk, but, when she attained an erect posture, the pelvis tipped forward and downward, throwing the sacrum backward, consequently flexing the spine in the lumbar region, which continued to increase more or less rapidly, according to amount of exercise the child was permitted to take upon her feet.

Some two years before you saw it, my attention was called to increasing curvature of the spine.

At this time, and until treatment was commenced, the child could walk, run, jump, and carry burdens equal to any child of her age; but, when standing, the axis of the superior strait of the pelvis, instead of being upward and forward, was downward and forward, at an angle of less than ninety degrees with femur, and a line dropped from shoulders to sacrum would leave the lumbar vertebræ some three or four inches in front.

At this time the trochanters were still more prominent, drawn a little upward and backward, but upon the patient taking a recumbent posture, and flexing the femurs, a little traction would bring the trochanters to their normal position, and permit the pelvis and spine to resume theirs.

Even when in a recumbent posture, extending the limbs would tip the pelvis forward, flex the spine, and protrude the trochanters, crowding the head of the femur out of the acetabulum, as far as the relaxed ligaments would permit, the upper edge of which, I supposed, was battered off.

When limbs were extended, the tendons of the sartorius and tensor vaginæ femoris could be felt prominent and very tense.

About this time I consulted Dr. Moore, who advised the cutting of these, together with that of the rectus, and then confining the child to a recumbent posture, with extension to limbs. This course we agreed to adopt.

Subsequently, and before we cut the tendons, I met Dr. Parker while attending the A. M. Association, to whom I mentioned the case.

Dr. P. concurred with us in advising the cutting of the tendons of sartorius and tensor vaginæ, but said that we need not cut the rectus, as a proper apparatus would keep the spine straight, and the hips in their place, and elongate the shortened muscles, all the while permitting the child to take exercise, and keep her general health good. Upon our return we concluded to adopt his advice, and in a week divided said tendons, which permitted the pelvis and spine to return to their proper position by a little support, while the limbs were extended. As soon as could be borne, we intended applying an apparatus to keep the parts in their proper position.

Before the apparatus was applied, Mr. O. negotiated with a Dr. Man to treat the patient, and, some four or five months after we divided the tendons, the treatment was commenced under your supervision. During this time we had no responsibility in the case, and the child was permitted to continue her unrestrained exercise as usual.

Remarks.—This case is of importance in several particulars. In the first place, it shows very conclusively *one cause* of congenital dislocation and deformity.

We have, at the birth of this child, both tibia turned upon the anterior surfaces of the femurs and retracted an "inch and a half," as stated by Dr. Palmer; feet "firmly pressed upon the abdomen; thighs (femurs) at right angles with the body." "The knees were also drawn close together, and even with difficulty separated sufficiently to cleanse and apply necessary linen." "The trochanters appeared a little prominent, and pressed upward and backward, and the more so when the limbs were straightened. But, upon a little force being applied while the femurs were flexed, the trochanters would occupy their proper place; but upon every effort to straighten the thighs, the trochanters would tilt upward as far as the ligaments (which appeared relaxed) would permit; at the same time, the pelvis would tip forward and follow the femurs, bending the spine in the lumbar region, throwing the sacrum back, and bringing the spinous processes of the ilia forward and downward."

It appears from the statement of Dr. Palmer, that at birth both tibias were turned upward upon the upper surfaces of the femurs, without any malformation of parts, except shortening of some of the soft tissues about the joints.

That all the parts were normal, except as to position, is proven by the result of treatment, as they are now in position, and perfect in function and appearance.

The doctor also states that the heads of both femurs were thrust upward and backward; thus we have both tibias turned upon the upper surface of the femurs and retracted an inch, and the femurs luxated on the dorsum of the ilia at birth. Can this condition of the parts be satisfactorily accounted for by the operation of any mechanical cause affecting the child in utero?

The mother says that, during gestation, she experienced a "hurting sensation;" that it gradually increased during the latter months, until it was as severe as the labor pains with her other children, and finally resulted in premature labor at the eighth month. What was the cause of this peculiar " hurting pain," and had it any connection with the deformity of the child? We are of the opinion that they were both dependent upon one and the same cause.

That the lower limbs, by some means, were turned forward upon the body until they passed the point of greatest resistance of the curve formed by the walls of the uterus, and being forced backward at the knee, until the pressure upon the feet carried the point of pressure at the knee back of the centre of the line of the whole limb, as in an artificial limb, and the pressure from the uterus remaining constant, in consequence of the irritation of its walls from the unnatural position of the limbs, they were continually forced backward, gradually doubling upon themselves, until they were in the position found at birth. This position of the tibias prevented the femurs from flexing upon the body naturally, and brought the contractile force of the uterus to act upon their condyles, and gradually obliging the parts about their pelvic articulations to yield until they were in the position described by the accoucheur.

In this position of the fœtus, the several parts formed an imperfect triangle. Place this triangular body in a cavity like that of the uterus, and we have pressure upon the ischia, the head and neck, along the back, and upon the condyles of the femurs and head of tibias.

This unnatural angular position of the child would necessarily irritate the walls of the uterus, causing pain and soreness, a constant tendency to contract, and effort to expel the contents, as if they were some foreign body.

This unnatural position undoubtedly took place in early fœtal life, and, as the fœtus grew, the pressure from the walls of the uterus was increased, gradually elongating all the soft tissues put upon the stretch. It is probable also, that, after the head of the femurs was displaced, the growth of the parts was arrested from this cause and the effect of pressure combined.

This view accounts for *all* the phenomena observed in the case. The malposition of the limbs in utero irritated its walls, producing the "hurting pains," the contractions, the pressure, and consequent elongation of the soft parts, admitting of the luxation of the joints.

This case corroborates the principle which we have elsewhere laid down, that soft tissues can be elongated to any desirable extent, and, by acting upon it, we can restore deformities dependent upon this contraction or actual shortening.

TREATMENT.

In this case, extension was applied by means of adhesive straps, the cord, pulley, and a weight of eight pounds. The patient rested upon a mattress during the night, but was permitted to sit up during the day, keeping up the extension in both positions.

At the end of four months, the limbs were brought down to their normal position, all their motions were as free in every direction as natural. The head and neck of the right femur was very small, that of the left perhaps an inch long, judging in both cases by the arc formed by rotating the femurs.

We indulge the hope, considering her age, and the fact that the parts are now in position, and subject to performing all the functions of a joint, that the neck and head will now grow in the same ratio with the shaft of the femur. There is at present no interference with the law of formation, as was the case while in their abnormal position. So far as we can conclude from these premises, there is nothing to prevent their growth with the other parts.

If this reasoning should prove correct, or even partially so, it will afford great encouragement for efforts in these cases, and advance the science of our profession another step in the means to be used in overcoming deformities.

Professor Hamilton examined this case very critically, and was satisfied it was one of congenital luxation of both femurs. It is designed that passive motion should be practised several times a day, to stimulate the most rapid growth, as well as to promote the formation of all the parts of a joint. Much of this is experimental, yet it is based on what to me appears a very good foundation.

If only a portion of the cases succeed, it will be a valuable discovery.

It may be said that these limbs were not dislocated, *because* they were not more adducted, and because flexion and extension were natural. This can be accounted for by the fact that the head and neck were so slightly developed as not to exercise any leverage upon the shaft of the femur; therefore there was nothing to rotate them as in ordinary dislocations, when these parts are fully developed. In another case which I shall relate, the position of the limb was as marked as in a recent dislocation in an adult.

CASE II.

Ella, daughter of Garret Garretson, Muscadine, Iowa, aged fourteen, came under my care January 16, 1865. Found the left limb two inches shorter than the other, strongly adducted and rotated inward, placing the foot across the body at nearly right angles with its natural position. The whole limb was in that position assumed in a recent dislocation of the head of the femur upon the dorsum ilii. The outer border of the foot was calloused, as in club-foot. The muscles connected with the tendo-achillis were permanently shortened, drawing the heel high up. All the motions of the foot were restrained, in consequence of having so long remained fixed. The limb could, by the application of strong force, be rotated outward sufficient to bring the patella in front. Abduction was impossible. The trochanter was three-quarters of an inch above the superior spinous process of the ilium, and half an inch farther back than that of the sound limb. The head could be distinctly felt upon the dorsum ilii on rotating the shaft of the bone. Extension by the hand did not change the position of the head.

The artist has not succeeded in giving a good illustration of the position of the limb. The foot should stand more directly across the body.

From the history of the case given by the father, luxation had existed from birth; if so, it must have taken place at or near the full period of uterine life, as the head and neck were fully developed, which, we are inclined to think, would not be, were it to take place in the earlier months. It possibly might have occurred at birth, or soon after, and not have been discovered until she began to stand upon her feet.

She had worn apparatus for straightening the limb, and more particularly the foot; but this was impossible so long as the dislocation remained unreduced; the head and neck mechanically confined the limb in the position described. There had been no attempt to reduce the dislocation, as it had not been suspected. The difficulty had been considered in the ankle and treated accordingly.

In this case, unlike No. 1, the femur had a well-developed head and neck. These gave to the limb the exact position taken in a recent luxation. Without a fair length of neck and size of head, the limb will not be obliged to assume this position. This was illustrated in No. 1. This fact should be borne in mind when this difficulty is under examination, for it has been asserted with much confidence that this position of adduction and rotation inward should always be found in congenital luxations of the femur upon the dorsum ilii.

TREATMENT.

Elastic extension was applied to the limb in the same manner as directed in morbus coxarius, by a weight of eight pounds. After three weeks the limb was frequently abducted as far as would be permitted without removing the extending force, while at the same time one hand was placed above the trochanter, pressing it downward and inward, while the limb was steadily brought to its extended position.

The precise time when the head came into the acetabulum we are unable to say; the soft tissues elongating gradually, the restoration of the joint was without any marked feature to denote it.

From this time we are not aware that the head left the acetabulum. When the weight was removed for a few minutes, the limb remained in its natural position, but the patient was not allowed to rest any weight upon it.

It will be noticed that, not only are the contracted ligaments and soft parts about the joint elongated by this mode of extension, but those before extended are, during the same time, shortening, and an equilibrium of forces is established; consequently there is no force acting to displace the head of the femur after it is restored to the acetabulum. The foot was treated for talipes by our mode, and, at the expiration of three months, was not only in position, but she could, by a voluntary effort, raise her toes two inches by the flexor muscles, the control of which she had previously entirely lost. It is almost certain that the entire limb will become as perfect as the other.

PSEUDO-ANCHYLOSIS OF ULCERATED JOINTS.

It has always been the settled opinion of the profession that, when varied manipulations failed in detecting any motion of a joint which had been previously ulcerated, it was certain and positive evidence that such joint was united by bone, or truly anchylosed.

From an experience running through many years, we have come to the conclusion that true anchylosis *seldom, if ever, takes place in an ulcerated joint.* In traumatic injuries, followed by inflammation of the periosteum, anchylosis may ensue. So in rheumatic inflammation of a joint, affecting the periosteum, bony union may result; but in the low grades of inflammation, terminating in ulceration, we doubt if true anchylosis ever occurs.

What appears as anchylosis in ulcerated joints is a shortening of all the ligaments and soft tissues about the parts to that degree, that they actually prevent any motion. This condition of the ligaments and soft tissues is in accordance with the law we have before mentioned, viz., that, if the distance between the origin and insertion of a ligament or other soft tissue be for a length of time shortened, and remains so without interruption, the ligaments and soft tissues will gradually conform in length to this changed distance between their points of origin and insertion.

This is exactly the reverse of the condition and the law, when these tissues are drawn tense, or, in other words, when the points of origin and insertion are separated as far as these tissues will permit and are there retained.

When the ligament is for a time lax, uninterruptedly so, the useless parts will not be reproduced. This gradual lengthening and shortening of ligaments and other soft tissues, under the circumstances described in these pages, should always be borne in mind, that we may turn the results to our advantage.

As in mechanics, so in surgery, the right means appear especially designed for the particular case that brings them out. In this lengthening and shortening of ligaments, the law that governs the process appears as though it were designed by the Creator for the very purpose for which we wish to use it. Take a deformed foot or ankle, for example; the ligaments upon one side are shortened (as we generally express it), and will not allow of an immediate restoration of the parts. But even would they permit it, there would be nothing to hold the parts in their place; the ligaments opposed to those shortened are as much too long as the others are too short; therefore they require shortening as much as the others require lengthening. Here the law comes in which we have stated, and accomplishes both by the same process and at the same time; an incomparable adaptation of means to ends. Instead of one process for one purpose, then another for the opposite, we have a simple, effective one for both.

TREATMENT.

From what has been said, the treatment is obvious. The ligaments, and all the soft tissues about the joint connected with that portion of the limb which is shortened, are to be elongated by "continued elastic extension," until they will admit of free motion in every direction. When the parts are liberated by this process, the surroundings of the joint serve as firm walls of support, and, when motion is added, they will perform, by gradual change of structure when necessary, all the functions of a joint. If motion is restored by rupturing these bands, the surroundings of the joint are very much weakened, and a process of restoration must go on, requiring some considerable time before they will acquire sufficient firmness to prevent shortening by contraction of the muscles or the weight of the body, or by both conjoined.

Continued elastic extension readily elongates these bands, without lessening in any degree their capacity for resistance in performing the functions of a joint.

A joint can be liberated by this mode of extension, without danger to life, without suffering, and in a shorter time than by any other process—shorter in so far as the time required in regaining the uses of a joint are concerned, for, as soon as the parts are liberated, motion is restored, and the surroundings of the joint, retaining their full strength and firmness, will readily endure the ordinary labor required of a joint. We have in several cases restored motion after ten years of pseudo-anchylosis, and in one, that of a lady, after it had existed for seventeen years. In this case, motion was palpable in four weeks. As her limb was three inches shorter than the other, we advised an artificial foot and ankle, which was furnished by Dr. Hudson, of this city. This gave her a full length of limb, and enabled her to walk with ease and safety, and with scarcely any perceptible irregularity in her step.

This limb had been examined by a large number of surgeons with special reference to its being anchylosed by bone, and they all said there was bony union, and that it would be useless to think of restoring motion.

PSEUDO-ANCHYLOSIS OF JOINTS FROM RHEUMATISM.

This condition of joints from rheumatism is more common to persons past middle age, yet it sometimes occurs as the result of a single attack of rheumatic inflammation of a joint in young persons. We have in these cases the same mechanical impediment to motion that exists after ulceration of a joint, viz., a shortening of all the tissues about the joint, together with that rigidity of the muscles common to rheumatism. The pain consequent upon motion induces or compels the patient to keep the limb in one position. If the limb is moved, there takes place a corresponding movement of the body, so that the joint has not changed or been affected by the movement of the limb. This places the joint in the same condition mechanically that exists in ulceration of the same parts. The bony structure being stationary, the ligaments, muscles, and other soft tissues are gradually conforming in length to this fixed position of the bony structure, which is generally one of semiflexion, in order that the muscles may be relaxed as much as possible. There is frequently one important difference between a joint fixed by rheumatism, and the same fixed state following ulceration of a joint.

When the fixture follows ulceration of a joint, there is no permanent rigidity of the muscles. When they have been elongated by extension, the limb can be moved freely within the distance allowed by the tissues; but, in fixture from rheumatism, if the flexed position of the limb is overcome by extension, it may be as fixed and immovable in this altered position as before the change. This is the effect of rheumatism upon the muscles, and is to be overcome by remedies indicated in that disease; yet extension is as necessary as when not caused by rheumatism. If the use of the limb is not painful, regular exercise is important, and one of the best means of overcoming the rigidity of the muscles. It will be understood that we are speaking of a chronic rigidity, and not of the rigidity that exists during the inflammatory stage.

An interesting and severe case of this condition of the joints came under our care in 1864. Miss B. C., of Massachusetts, aged eighteen; four years previous had been in the Massachusetts General Hospital, and was there treated for morbus coxarius. The limb was placed in some kind of splint, for the purpose of giving the joint perfect rest, but this, causing severe pain, was removed, and after a time it was enveloped in a starch bandage, which was worn several months. The joint gradually improved, became less sensitive and less painful, but semiflexed upon the pelvis, and pseudo-anchylosed. Two years from the first attack, the other limb became similarly affected. She had been suffering with this two years when she came under our care. The limb last affected was yet very painful and rigid. Both limbs were so much flexed upon the pelvis that she was unable to support the centre of gravity upon her feet. Could bear her weight by leaning upon crutches, but was unable to move her feet when in this position. Upon a careful examination of the hip-joints, there was no discoverable alteration in their external appearance, no flattening of the nates, no shortening of the limbs at the hip-joints, when compared with the superior spinous processes of the ilia; some abduction of both limbs, but most of the left, the one first affected, and perhaps a little fullness over the region of the great trochanters. The pulse was more frequent than her condition would seem to warrant, her cheeks generally flushed, yet the skin did not indicate increased heat; the appetite limited, bowels costive, urine scanty.

There was no indication that the difficulty had ever been ulceration of the joints; there was no shortening, no change in external appearance, which certainly would have taken place, had ulceration been going on in the joint for four years, or even for two years, the time the right limb had been affected. There was not, nor had been, that constitutional condition which we generally find during the progress of morbus coxarius, and certainly it should have been present were both joints diseased; yet, so far as we could judge from the account of her previous condition, her general health had not at any time been materially affected.

Although the case was somewhat obscure, the evidence led us to a different conclusion from that of the eminent surgeons of the Massachusetts General Hospital, and we could but consider her present condition as the result of rheumatic inflammation of the joints.

We called in council Dr. Gurdon Buck, and his view coincided with our own.

Continued elastic extension was applied to both limbs, through the medium of adhesive plasters, the cord, pulley, and weight, at first eight pounds to each limb, afterward increased to twelve. The effect was slow, in comparison with that upon contracted muscles in cases of ulcerated joints. At every stage of the straightening, the limbs were as fixed as at the commencement, the rigidity of the muscles remaining the same after the limbs were in position. She was now able to stand erect and balance herself upon her feet, and soon began to move her feet and walk with the aid of crutches, gradually increasing the distance without fatigue. We gave her encouragement that the warm weather would be of advantage to her; in this we were not disappointed. We first heard of her taking long walks in the street on her crutches, then with a cane, and lastly, that she had discarded the cane. There remained only a slight stiffness at the joints.

• MUSCLES AND TENDONS.

THE correctness of our reply, submitted in answer to a question which arose during a discussion at the Academy of Medicine, in this city, some years since, as to the practicability of effecting elongation of muscular and other tissues sufficient to insure permanent recovery from deformities and diseases of joints, kept up by contraction of those tissues, and which was given to the effect that "we can do any thing we please in the way of effecting elongation of the soft parts, if extension be continuously and perseveringly performed," having been fully substantiated and attested by many permanently successful cases in the mean time; we now propose to give, in a general way, some of the accidents and abnormal conditions to which the muscles and tendons are liable, and to make some suggestions in relation to treatment, in anticipation of dealing more in detail upon certain subjects, only heretofore hinted at, when we come to their subdivision.

Without entering into an extensive dissertation on the different kinds of malformations, accidents, or diseases, to which muscles and tendons are liable, we will confine our remarks to such conditions, in which our plans of mechanical treatment seem applicable, and among these may be mentioned rupture of a muscle. With this view we propose to show that such an accident may be successfully treated, through the medium of the contractile properties of rubber webbing, the strip of rubber being stretched, and the ends fastened over the separated portions of muscle by adhesive plaster, in such manner as to allow of steady retraction, and gradual approximation of the severed parts, upon the same principle sought to be attained by the adhesive strips and weight used to approximate the two segments of the patella in fracture of that bone, to which this method is also applicable, and which has been before fully explained in the management of certain fractures.

As is well known, the usual causes of rupture of muscles and tendons are jumping or leaping, lifting heavy weights, falls, during which the patient makes great effort to arrest his progress, and similar sudden efforts at recovery in cases of misstep or stumbling; and those most liable to this accident are the psoas, deltoid, the straight muscles of the abdomen, and the flexor and extensor muscles of the extremities.

Cases have occurred of rupture of the muscles of the abdomen during parturition, and such an accident may involve rupture of the epigastric artery.

When a muscle is ruptured, which is especially liable to happen when suddenly and violently called into action after long-continued inactivity, the patient becomes aware of injury by local pain, severe and persistent, with want of control of the part moved by it, and, if accompanied by a wound, its edges are more or less drawn asunder by retraction of its fibres.

The tendons are not so liable to lacerations and inflammations as the muscles, and are only secondarily involved in malignant diseases; but inflammation of the sheaths of tendons may occur from contiguous inflammation of surrounding parts, giving rise to serious deformities, from adhesions of the thecæ to their tendons.

M. Velpeau, of Paris, describes a case of painful crepitation of the tendons which was suspected to be a fracture of the radius, but which resulted from thecitis. The rupture of the muscle usually takes place near the place of union of the muscular fibres with their tendons, but is liable to occur at any other part, and may be confined in its extent to a few fibres, or may involve the whole thickness.

Sedillot reports twenty-one cases of rupture of muscles, in thirteen of which the lesion occurred at the juncture of the tendinous fibres with the muscular, and, in the remainder, in the body of the muscles.

In connection with the pain which enables the patient to localize the seat of injury, upon examination, a depression will be observed, caused by the separation of the divided ends, if occurring in the substance of the muscle, and also an unusual prominence on either side, caused by retraction of the divided halves, followed by discoloration.

Inability to use the affected part until the torn structures have united, and which will require considerable time, is usually the most untoward result of this accident; but a case is recorded of death supervening from rupture of the psoas muscle, and consequent inflammation and suppuration.

We have seen but two cases of rupture of muscle: One, while Assistant-Surgeon at Bellevue Hospital, in this city; the other in private practice.

The case at the Bellevue Hospital was that of an adult who ruptured a muscle in the act of falling. The other was a boy two years old, and the accident happened while he was hopping and skipping. He suddenly cried out, soon turned pale, complained of feeling cold, and fell asleep.

Afterward the limb below the knee was found to be swollen and unusually white. The child being too young to talk, we were limited to local appearances and the history of the case in forming our diagnosis, which was rupture of a muscle, and that there had occurred hemorrhage into the surrounding tissues, which, if slight, would be absorbed, and no abscess would form; but if the hemorrhage were considerable, an abscess would form, the contents of which would be coagulated blood and pus. An abscess did form, and the contents were as predicted. This boy recovered as readily as from any abscess.

This difficulty was considered, by two medical gentlemen of ability, as periostitis—a mistake which might readily be made, particularly if the case were seen for the first time after inflammation from extravasated blood had supervened, and which strict inquiry into its origin only could elucidate.

Atrophy of a muscle may follow a blow, especially if its nerve has been injured, and this condition has been known to follow upon a sharp, severe blow upon some of the muscles of the hand.

After the lapse of an indefinite period from the receipt of severe injury to a joint, the muscles acting upon it sometimes pass into a state of fixed contraction, or may start into spasmodic contraction upon any effort being made to move the joint, either voluntarily or by the attendant. This condition may give rise to the impression that the joint thus stiffened has resulted from improper treatment, and that the dislocation or fracture, if either have occurred, has not been reduced, and anchylosis may be apprehended; but in such cases, as we have before maintained, the apparent anchylosis is due to contraction of the muscles alone, as may be proved by giving the patient chloroform, when, after sensibility to pain is allayed, and the will of the patient being, for the time, in abeyance, the joint will yield to passive motion. This condition has frequently occurred in affections of the knee, elbow, and hip-joints, and is one in which our plan of overcoming the contraction of muscles by "continuous elastic extension" has proved particularly serviceable.

This action of the muscles is not dependent upon any disease of their fibres or of their nerves, but is simply a contraction for the purpose of preventing, instinctively as it were, motion in parts, where motion is productive of pain.

The more severe the pain excited by motion, the more fully will all the muscles of the body sympathize.

In morbus coxarius, we have seen the whole body in a tremor upon any person's approaching the bed of the patient, who has so great a dread of any movement or jar that it amounts to a horror.

We have heard them assert that even talking about moving them excited severe pain.

This constant contraction of muscles passing over a joint, thereby guarding with increasing vigilance against motion, when all movements of the joint give pain, is the efficient cause of the destruction of the parts pressed upon or against each other, and should always be counteracted.

There is also a condition of the muscles which, from the attendant pain, may simulate other painful affections, as pleurisy, peritonitis, neuralgia, disease of the bladder, kidney, or uterus, and is associated with debility of the system.

The pain is hot and aching, does not follow the course of the nerves, and is usually accompanied with tenderness on pressure. The muscles and tendons will not bear the least tension; stretching of the muscular fibres and overfatigue may be the cause; at least they aggravate the myalgia. The indications here are to approximate the origin and insertion respectively of the muscles involved, and to give such remedies as are calculated to improve and build up the tone of the system.

Myositis, or inflammation of the muscles, causes contraction of their fibres, and although the disease is primarily of the muscles, yet this contraction, by holding the articular cartilage and bone surfaces in unremitting contact, strangulates the nutrient vessels, producing ulceration of the impinging surfaces. While we may almost say that it has always been known that constant pressure, to the extent of impeding capillary circulation in the soft parts, will cause eventually erosion and destruction of the tissues, and that atrophy, both of the muscular and osseous tissues, will ensue upon long-continued disuse of a limb in obstinate fractures, we believe the attention of the profession had not been called to the fact before our publication of papers some years ago, setting forth that the same disintegration of the osseous substance occurs from strangulation by pressure of the nutrient vessels of bone and cartilage, caught between the articulations and held by contracted muscles, and thus causing destruction of the bony surfaces, as certainly as too tight bandaging will eventuate in gangrene.

Myositis may be dependent upon a rheumatic diathesis, and occur idiopathically from exposure to wet and cold.

We apprehend that many of the deformities of joints occurring as the sequence of protracted articular rheumatism, may be ascribed to continued pressure of the impinging surfaces of the joint. Authors ascribe this to extension of the inflammation to the surrounding muscles, and consequent contraction; but we think that such explanation is incorrect, for the reason that we often have a fixed state of a joint at the very commencement of a disease at all painful, before much inflammation has become developed.

Whenever it is painful to a patient to have an affected joint moved, he instinctively holds it still, and this is not altogether a voluntary effort, as he maintains it even while asleep; and, therefore, we hold that, notwithstanding passive motion will give rise to pain, the application of our process of gradual, and at first slight extension of the muscular fibres implicated, by means of *elastic extension*, will be found, in conjunction with proper topical and constitutional treatment, not only to materially relieve present pain, but will conduce to a more satisfactory state of the joint itself after the inflammation has been subdued.

Muscular rigidity or contraction may also result from syphilitic taint, and is probably caused by extension of periosteal irritation.

Rupture of the aponeurosis by a blow may cause the peculiar condition known as hernia of the muscle. A man was admitted into the Hôpital de la Pitié, Paris, with a soft influctuating, nearly colorless tumor, about the middle of the anterior surface of the limb, with pain, swelling, and inability to walk. He had received a violent contusion by the fall of a piece of timber upon his leg. Lisfranc diagnosed a muscular hernia of the tibialis anticus through the ruptured aponeurosis.

Luxation of muscles may result from the unequal contraction of the muscles of a limb, one muscle acting alone, or being contracted more powerfully than any of those which should concur in the movement, resulting in a condition similar to muscular hernia. Long thin muscles only are liable to this luxation, while those which are short and thick are not so exposed. A relaxed muscle, placed between two muscles contracting powerfully, may be forced forward, or, if one of the flexors of the foot, on the other hand, contract alone, or with more force than the other flexors, it may be thrown by the irregularity of this contraction out of the place which it occupies among its neighboring muscles, and cannot return without artificial assistance, since the contiguous muscles immediately fill up the space made vacant by this displacement.

In such an accident, we should treat the case by *continuous elastic extension*, gradually tiring out the contractile force of the muscular tissues, as in the reduction of a dislocation or fracture, together with compression over the displaced muscle or taxis, as in hernia, to crowd it back into its proper place.

Permanent involuntary contraction of muscles should be treated by placing their origin and insertion as far apart as practicable; this secures a forced extension of them, and, being maintained in this state for some time, their opponents will gain strength, and the balance of power will be restored.

This condition of the masseter muscle has been cured by the gradual insertion of a wedge into the mouth.

Wry-neck, caused by involuntary contraction of the sternocleido-mastoideus, has often been cured, in recent cases, by turning the chin to the opposite side, and retaining it there for some time by mechanical means. Our treatment, although upon the principle of counter-extension, really assists the weakened opponent of the contracted muscle, and allows the patient scope for voluntary movements of the other muscles of the neck, while keeping up *constant elastic extension*, thus serving to strengthen the debilitated muscle on one side by exercise, while overcoming the morbid status of the other.

The muscles of the shoulder-joint may get into this condition after accidents, rendering the arm of very little use for a long time. This has been cured by placing the bend of the elbow on the crown of the head, with the fingers touching the ear on the opposite side, and keeping it in that position for several hours.

Sometimes, after treatment for fracture of the forearm, the biceps remains for some weeks in a state of contraction, and also the muscles of the fingers after injuries of the hand. The extensor or flexor muscles of the thigh may be left in this condition after long continued, extended, or bent position of the limb in the treatment of injuries; and the same may occur to the gastrocnemii and other muscles of the leg, during treatment of diseases or injuries of the foot or ankle-joint; and frequently are as troublesome to remedy as the original disease.

In those peculiar rhythmical movements, characterized by bowing movements of the trunk, rctatory movements of the head, vibration of a single limb, and in certain cases of chorea, there is probably no reason to doubt the auxiliary benefit the constraint of the muscles implicated would afford, without interfering with the usual medication.

It seems to us that medicines would exert more favorable influences after the parts were placed at rest by artificial means. These morbid rhythmical movements are considered by some authors to depend upon disease of the cerebellum; but we cannot fully subscribe to this, as, in cases of twitching of muscles concerned in giving expression to the countenance, their involuntary mobility depends upon perverted function of the set of nerves supplying the muscles concerned in what may be termed involuntary expression.

In certain cases of paralysis, which will be more fully particularized under the proper heading, the use of the *elastic extension* will be found of great benefit in enabling the affected member to regain its tonicity, and, as an example, we may mention its use in cases of paralysis as it sometimes occurs in children.

To a non-professional, in paralysis of the face, the difficulty seems to lie upon the side contracted, the blank side of the face seeming to be irresponsible for the deformity. In these affections we propose to adjust the power of the weakened and inefficient muscles by means of the counteracting force of *continuous extension*, as hereinafter explained.

Regarding the propriety or necessity of performing the operation of tenotomy in cases of disease of joints, we have heretofore expressed our disapprobation, believing, from experience, that there is no necessity of performing section of any of the soft parts previous to commencing *elastic extension*.

It will be found, upon reference to their proper headings, that we gain as surely, and with much more safety, the objects usually sought by tenotomy in the treatment of the several varieties of talipes and other affections of joints, by using apparatus exemplifying the soundness of the principle that "Nature will not yield to violence, but only to a gradual force."

There are conditions of the tendons, however, in which tenotomy not only is indicated, but has produced remarkable effects.

According to Dr. James Braid, of Manchester, England, a rigid and permanent contraction of one or two muscles may be sufficient to exhaust the whole nervous and muscular energy of the leg or arm where it occurs, so that there shall be a loss of heat, feeling, and muscular energy of the whole member—all of which may be restored with so much rapidity, by simply dividing the tendons of the contracted muscles, that it would be no difficult matter to make superstitious people believe that a miracle had been performed.

In cases of contraction of the hand and fingers and arm, from any contraction of the biceps, long flexors of the wrist and fingers, &c., the division of their tendons has, in many instances under his care, been followed by the most surprising results. Not only have the hands and fingers been set at liberty, but such increased energy to the whole arm has been restored, that patients of upward of thirty years of age, who had been deprived of the power of lifting their arms for five or six or more years, have, in the course of two or three minutes, been able to lift them to their heads; and he mentions one patient, upward of seventy years of age, who had paralysis of the right side, and had been dumb for three or four years, and who, in eight or ten minutes after the operation, was able to lift the arm pretty freely, and the following morning spoke for the first time since his paralytic seizure.

In explanation as to the cause of the restoration of power and feeling after these operations, Dr. Braid infers that a certain amount of nervous energy is elaborated for each member for the general supply of the whole of its functions, and that the quantity necessary to maintain these muscles in this state of morbid tension produces enervation of all the others, with loss of tone, and languid circulation. The operation, by cutting off this profuse expenditure in one channel, allows it to flow for the general benefit of the whole; and hence the muscular power is restored, with freer circulation of the blood, which will of course produce an increase of heat in the whole member.

Mr. Braid follows his cases of tenotomy at once with extension, to maintain the advantage gained by the operation, and to insure a new portion of tendon growing into the separated ends, only waiting until the cutaneous wound has closed and lymph has been effused. The tension is then commenced, to obviate a recurrence of the original contraction and feeble state of the member.

If this recurrence is liable to ensue upon healing of the severed tendon, without intermediate extension, so as to insure elongation, we would ask wherein lies the necessity for performing tenotomy at all? Before reading Dr. Braid's paper, we were accumulating evidence to show, from our own experience, that, in cases of paralysis where certain antagonist muscles were contracted, the elongation of these muscles by *continuous elastic extension* served, in some way, not only to increase the vitality of the paralyzed muscles, as evinced by the increase of heat in the part, but tended also to their enlargement, and increase of cellular tissue, and to a return of nervous influence, or an ability on the part of the patient to direct this nervous influence to the muscles paralyzed.

If this should prove to be a physiological result from elongation of the muscles contracted, then it will follow that it is not necessary to divide the tendons to insure the restoration of functions. This we have explained and illustrated more fully under the head of Paralysis.

There is no reason to presume that all the striking results described by Dr. Braid as following upon the operation, would not have occurred in course of time, if our plan of *gradual elastic extension* of the contracted muscles were followed, until the tendon and muscle were actually elongated to the requisite length; and there are many reasons, in the shape of successful cases, going to prove that the recurrence of the original difficulty does not ensue after treatment by our process—to say nothing of the liability to secondary accidents, as well as to accidents similar to the one published in the *Scalpel* of this city, issue No. 46, in which the operator, Dr. Sayre, in performing tenotomy upon a patient with disease of the hip-joint, cut, by mistake, the femoral artery, which eventuated in the death of the patient.*

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* The only published account of this case appeared in No. 46 of the *Scalpel* of this city; this report has, I believe, never been contradicted, but has been corroborated by medical gentlemen who were present. The facts appear to be, that the femoral artery was wounded, the cardiac side only was ligatured, hemorrhage followed from the distal portion, causing the patient's death. This is only one of the direct liabilities of the operation; secondary accidents will occur, and are well known to surgeons.

TALIPES, OR CLUB-FOOT.

THE name of Talipes has become adopted as the generic term for these distortions of the feet, and four distinct varieties are conceded, namely: *Talipes Varus*, *Talipes Valgus*, *Talipes Equinus*, and *Talipes Calcaneus.*

Compound varieties have received corresponding appellations, as *Varo-Equinus*, *Equino-Varus*, *Equino-Valgus*, *Calcaneo-Valgus*, &c.

1. *Talipes Varus* implies that condition of the foot in which the muscles of the calf of the leg, and those which turn the foot inward toward its fellow, together with their tendons, are contracted, by which the heel is drawn up, and the foot is made to turn inward, the toes to assume a vertical position in contact with the floor, instead of a horizontal or flat position as is natural, with the outer margin of the foot and heel in contact with the ground during locomotion.

2. *Talipes Valgus* is characterized by contraction of the muscles of the calf of the leg and their tendons, and those which turn the foot outward away from its fellow.

The natural arch of the foot is wanting, and the inner margin of the foot and ankle touches the ground in walking.

3. *Talipes Equinus* is attended with contraction of the muscles of the calf of the leg alone, and the subject of this deformity walks with the toes resting upon the ground, while the heel remains elevated.

4. *Talipes Calcaneus* is accompanied by contraction of the muscles and their tendons, which lie on the front aspect of the leg, in consequence of which the dorsum of the foot is drawn up toward the anterior surface of the leg, with which it forms a more or less acute angle, while the heel only rests upon the ground during progression.

TALIPES VARUS.

This deformity is, in the majority of cases, of congenital origin; but may be developed after birth by mechanical causes, as bandages and splints, by which the parts are compressed and forced into abnormal positions, and so retained until the soft structures, the muscles and ligaments, are moulded in their new positions.

Similar results may arise from, or, at least, occur cotemporaneously with nervous irritation, convulsions, dentition, fractures, sprains, contusions, partial luxations, and abnormal laxity of antagonistic muscles and ligaments.

It may also arise from some cause which induces an unnatural position in walking, as the presence of an ulcer, or a corn, in such situation as to compel the patient to walk on one side of the foot, or on the toes, or heel, to ward off the pressure from the affected part.

Such habit, if persisted in for a long time, is apt to establish irregular action of the muscles, and consequent malposition or distortion.

Although the subject of congenital club-foot is one which has engaged the attention of the profession since the days of Hippocrates, its etiology is not yet definitely settled.

Various hypotheses have been advanced, from time to time, in explanation of this deformity, among which may be mentioned that of *arrest of development*, *excess of development*, *pressure of the uterus upon the member during gestation from deficiency of amniotic fluid*, *and derangements in the nervous system of the fœtus*, the latter of which is the one more generally received.

In the majority of cases of talipes, the muscles are the structures primarily implicated, and, in infantile club-feet, the deviations seem to depend upon their contraction, as the position of the bones bears a very close relation to the extent of contraction of the muscles inserted into them, and, when such contraction is overcome, the bones may be reduced to their normal relations.

As the case progresses, however, and becomes one of long standing, the malposition becomes greater in consequence of the conjoint action of the contracted muscles, and the superimposed weight of the body in walking, and the bones themselves become more materially altered in shape.

The muscles concerned in producing talipes varus are the gastrocnemius, soleus, and plantaris, which merge into the tendo-achillis, and are thereby inserted into the tuberosity of the calcaneus.

In addition to the above, the two tibiales muscles, the tibialis anticus and the tibialis posticus, are contracted, and produce the rotation of the foot; and, as this rotation increases, the central position of the tendo-achillis is gradually deviated from, and the achillis tendon comes to act in concert with the tibiales muscles in effecting rotation and adduction of the foot. In some cases the contraction may have progressed so far as to throw out of their grooves the tendons of the tibiales muscles.

In addition to these, there is contraction of the plantar muscles merging into the plantar aponeurosis.

The contraction of these muscles, as well as others implicated in other forms of talipes, would imply undue relaxation and attenuation, perhaps from paralysis of their antagonists.

The great majority of cases of talipes varus are congenital, and as to the frequency of this distortion, statistics show that this form comprises more than fifty per cent. of all the deformities of the feet.

According to Duval, but one club-foot occurs in three thousand among the French; and in those congenital cases ascribed to defective innervation, the tibial nerve, as has been inferred from the experiments of Bonnet, is the source of the difficulty.

Cases of acquired club-foot are comparatively rare, and generally originate from some diseased condition of the spinal cord, and have been divided into the active and passive forms. The first, which is the less frequent of the two, manifesting itself in reflex action in both the extensors and adductors, the former of which usually preponderate.

The passive form is that of motor paralysis.

The prognosis of talipes varus is generally favorable, but declines in the same ratio as the case has become confirmed by age and use of the member for locomotion.

TALIPES VALGUS, OR FLAT-FOOT.

In this form, the plantar surface of the foot comes more or less in contact with the floor in walking, as before observed, in consequence of the flattening of the plantar arch.

Examples of partial deformities of this nature are seen in the African race, and may be considered hereditary with them.

This position of the feet is a necessary concomitant of the deformity known as Knock-knee.

This form of talipes is ascribed by Stromeyer to an atonic condition of the plantar aponeurosis, and relaxation of the ligaments which unite the bones of the tarsus with each other and with the tibia and fibula.

In this event, the contraction of the abductor muscles serves to twist the foot outwardly, so that the hollow of the foot disappears, and its inner edge touches the floor during progression.

Otherwise, the adductor muscles being stronger than the abductor, this deformity would be of rare occurrence.

Paralysis of the tibial nerve will give rise to this deformity; also diseases of the spinal cord. When the difficulty arises from paralysis, the leg is apt to become attenuated from arrest of development or derangement of nutrition, which condition of atony of the muscular fibres doubtless precedes the relaxation of the connecting ligaments and plantar aponeurosis.

Derangements of the nervous system during the dentitial period, and inflammation of the meninges of the brain and spinal cord, may give rise to the paralysis, and the adductor muscles of the foot supplied by the tibial nerve become paralyzed; but the peroneal nerve, which supplies the peronei muscles, abductors of the foot, retains its innervation, and the peronei muscles become preternaturally contracted.

Reflex contractions of the peronei muscles may arise from inflammation of the tarsal and tibial articulations.

The prognosis of this deformity is very unfavorable where resulting from paralysis, since mechanical appliances to overcome the contraction of the peronei muscles can do very little toward restoring innervation to the paralyzed tissues.

TALIPES EQUINUS.

This form of talipes is not usually of congenital origin, but is generally developed after paralytic affections, the gastrocnemius and soleus muscles and ligamentum plantare being contracted, giving the dorsum of the foot a very convex shape, the patient being unable to bring the heel down, and, if the extensors of the toes are simultaneously contracted, the patient walks upon the ball of the foot; but, if the extensors of the toes are not also contracted, the toes are turned under toward the sole, and the patient walks upon the dorsum of the foot.

There is, in the majority of cases, a tendency to deviate from a straight line with the leg, the foot being disposed to turn inward; constituting equino-varus, the extent of which is limited by the more or less full development of the malleolus internus.

In talipes equinus, instead of the relaxed condition of the knee-joint, as in varus, there is usually contraction of the flexors of the leg, by which the knee is slightly bent, and the limb, in consequence of the extension of the foot, being longer than its fellow, this contraction of the knee compensates and serves to adjust the difference.

Simultaneous contraction of the adductors of the femoris, particularly of the pectineus muscle, produces a turning inward of the whole extremity, in addition to the turning inward of the foot itself.

The greater the duration of this deformity, the more will the whole extremity have become attenuated and arrested in its development and growth, with diminution of the temperature of the limb, from sluggish capillary circulation.

In consequence of the aponeuroses surrounding the ankle-joint being very strong and thick, it is often difficult to determine all of the muscles implicated in the contraction, as the more powerful contraction of the tendo-achillis masks the effects of the smaller tendons, which do not come into notice until after the abnormal condition of the achillis tendon has been corrected.

The longer the tendons have been implicated in the contraction, the less innervation they manifest under the application of a galvanic current; but while they remain sensitive to any excitation, innervation still remains.

TALIPES CALCANEUS.

This form of malposition of the foot is directly the reverse of talipes equinus, and is the most rare in its occurrence of the several varieties of talipes. In standing and walking, the patient rests his weight upon the os calcis, while the dorsum of the foot is more or less in close proximity to the tibia.

The extensor muscles of the foot, the gastrocnemius and soleus muscles, are usually paralyzed, their bellies being soft and undefined, and the tendo-achillis equally flaccid.

The flexores of the foot, the tibialis anticus, and peroneus tertius, are contracted, even to the extent of raising the annular ligament of the ankle-joint.

The convexity of the plantar arch, if the case is in a young subject, especially if congenital, is apt to be diminished, and the general appearance of the foot and ankle is similar to that of posterior dislocation of the foot, the tibia resting upon the anterior trochlear surface of the astragalus, giving rise to extreme protrusion downward of the heel.

The recorded cases of this deformity have been so few as to leave in doubt their congenital or acquired origin.

Combinations have been observed between talipes calcaneus and talipes valgus and talipes varus, caused by the prevailing contraction of one of the flexor muscles of the foot over the other, and they constitute respectively the forms known as calcaneo-valgus and calcaneo-varus.

In all cases of talipes, the bones, ligaments, and muscles are liable to changes, commensurate with the extent of the deformity, and the length of time it has existed, and these deviations also occur in degree according to the different stages of each individual case.

The tarsal bones are generally more or less separated from each other, variously twisted on their axes, modified in shape, atrophied and irregular, or rough on their surfaces. The bones of the metatarsus and toes also partake of similar modifications, though in less degree.

In severe cases of long standing, the ligaments present material changes, being abnormally relaxed on the one hand, while their opponents are inordinately stretched on the other; and sometimes supplementary bands of new formation occur, of a fibrous, dense character, while the muscles, and in fact the whole limb, become attenuated, thin, and pale; and, if they have been a long time in disuse, may have become degenerated into soft fatty bundles, the other soft structures, at the same time, undergoing proportionate decrease in size.

Synovial burses are liable to form under the callosities formed by constant pressure upon the spot upon which the patient rests the foot in walking, which are liable to inflammation, much to the annoyance of the patient.

TREATMENT.—TALIPES VARUS AND TALIPES VALGUS.

We propose to consider the treatment of these two varieties together, as the principles are identical.

In the first variety, as heretofore pointed out, the foot turns inward toward its fellow; in the latter, its direction is reversed.

We have, *for the past fifteen years*, pursued the plan of treatment herein set forth, based upon our hitherto published principle of "*continued elastic extension*," the object of which is, to overcome the contracted and shortened ligaments and muscles. We also make use of what we term "*artificial muscles*," upon the principles elsewhere set forth in this work, when dwelling upon the treatment for overcoming contractions of healthy muscles, when their opponents are paralyzed.

Although in cases of talipes there may not always be paralysis in the strict sense of the term, yet there is the same difficulty to overcome in each case, when we undertake to restore the foot to its normal condition.

The patient has no control over those muscles which are the opponents of the contracted ones, and although we overcome the contracted muscles by artificial means, we have still to educate the muscles which have never been fully developed, and give them tone by passive exercise, by means of artificial muscles, which are to be continued until the patient has acquired the power of volition, the same as in paralysis of young children. By the plan of treatment which we pursue, the functions of the muscles which have laid dormant for so long are called into play, at first passively, but at length through the medium of the will of the patient, as they gain volume and tonicity.

We have long noted as a fact that, if a part be placed in an unnatural position, and retained there for a long time, the patient loses the power of volition after a while, in consequence of the brain ceasing to exercise its will over the particular muscles involved, and as a consequence of this neglect of volition, and want of exercise, the muscles themselves lapse into a state of atony, and eventual inability to respond to the will, which is equivalent to paralysis.

We maintain, therefore, as elsewhere discussed, that the muscles opposed to those contracted in cases of talipes are in the same *pathological* conditions as pertain in cases of *paralysis* from other causes, except that we have much more to overcome in congenital cases, or those occurring in young subjects—where the muscles never have been developed and educated by exercise to perform their proper functions—than in cases occurring in adults, whose muscles, previous to the condition in question, had, at one time, been accustomed to perform their duties.

In the one case, they never had learned the lesson; in the other, they revive one which had, for the time being, been forgotten.

If we wish to restore the functions of the foot in talipes, we must restore tone and ability on the part of the muscles in abeyance, to contract, and as they are unable to respond to the will, it becomes necessary to resort to the use of artificial muscles in the place of those incapacitated, which should be so adjusted as to simulate the natural movements, and to overcome the contracted opponents.

If they be properly adjusted, it will be found that, as soon as the patient withdraws his will from the contracted muscles, the artificial muscles will contract, in consequence of relaxation of the contracted muscles from removal of the will, and the limb will be straightened.

The instant the will of the patient reverts back to the muscles capable of contracting, they do so, and the artificial muscle is again put upon the stretch.

By this movement the atonic muscles have been forced to passive exercise, and if this passive exercise is kept up, the muscles in time acquire tone, and, at the same time, the nervous connection between the brain and the muscles becomes established, and the balance of power restored, as the nerves participate.

But this does not fully explain all the part that the artificial muscle performs in the restoration of club-feet.

The rubber, when put upon the stretch, is a constantly *pulling* force against the muscles that are active, and not only active by their contraction to draw the parts into the deformed position, but they are actually shortened by being kept in this contracted state; this position has also left the ligaments upon the contracted side to shorten, according to the law we have elsewhere explained.

To remedy this shortened state of the muscles, ligaments, and other soft tissues, we must keep them unremittingly tense, that the *new material deposited* may go to lengthen them, which it *will not do* if the parts to be lengthened are not kept tense. In addition, and at the same time that these tissues are being lengthened, those upon the opposite side of the limb, whose function the rubber performs, being kept lax, are shortened by the same changed circumstances of nutrition. Hence, in the end, we have them of an equal length upon both sides of the deformed part. This office the "artificial muscles" perform, in addition to its educating and exercising those which fail functionally to do their duty.

In cases other than infants, we would place the patient upon a couch, and apply extension by means of cord and pulley, with weight.

If the muscles of the calf are to be elongated, we would apply adhesive strips over the bellies of the muscles that are contracted, in such manner that, when extension is made, the plaster will compress the muscles and draw them in the direction of the extension.

The same principle may be conjoined at the same time in bringing the foot into a natural position. This extension must be pursued, with a wearying force, and persistently, until the deformity has been overcome. It is also advisable to carry the parts in the opposite direction from the original deformity, so that more decided contractions of the artificial muscles may be effected, and a wider range given to the passive exercise.

When we have thus accomplished the liberation of the foot from its constrained abnormal position, our next step will be, to educate the patient to the exercise of his will upon the atonic muscles, for which purpose the surgeon, or some person, should give the patient daily lessons in guiding the foot in the right direction in walking, in directing the nervous current through the nerves supplying the muscles, which require tone, and generally in such exercise as will establish the ascendency of volition.

It becomes as necessary in such cases to teach the patient how to acquire the use of the atrophied muscles, as it does to teach the necessary steps in learning to dance.

The assistance of the artificial muscles, and the instruction of the teacher in walking, gives the weak atrophied muscle a chance to contract and elongate alternately its fibres, which exercise promotes growth, and places the muscle in a condition, in time, in which there is tonicity enough to enable it to contract in obedience to the will.

When the patient has fully acquired the power to exercise the weakened muscles by volition, it will be advisable to decrease the amount of artificial assistance used in effecting contraction, and to insist that the patient shall exercise frequently during the day, with the view of gradually dispensing altogether with the artificial muscles, in proportion as the power of volition and actual strength of the muscles will enable them to counteract their opponents, and maintain the foot in a normal position.

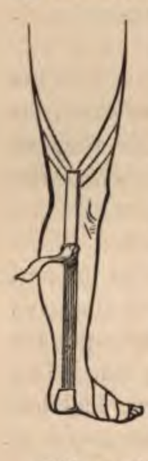
Inasmuch as the labor of sustaining the body erect upon the feet, during the act of walking, is too severe upon the muscles, at first, it will be advisable to have the disabled foot supported by a proper apparatus, and to allow the patient to walk only upon a level surface; but the foot should *always* maintain a correct position.

During all this time, the patient should not be allowed to lose sight of the important fact, that he must forget to walk as he did with the old abnormal position, and must constantly bear in mind how to place his foot down upon the floor, and how to take it up and move it forward, in order to acquire a new and correct habit of walking.

We have seen a child treated for talipes able to walk correctly; but the moment the attempt was made to run, the foot would relapse into nearly its old distorted condition; and the same effect would follow upon any unusual excitement of the nervous system. Therefore it will require patience and perseverance on the part of both the patient and surgeon, to effect a perfect restoration.

The difficulties in the way of restoration will gradually abate, as we succeed in overcoming the contractions, elongations, or shortenings of muscles involved; but there will yet be the condition of the deformed parts of the foot themselves, the twist or distortion incident upon their being so long held in bondage.

This twist we have usually remedied by applying a strip of adhesive plaster to the foot, by commencing at the toes and winding it spirally around the foot, toward and up by the side of the heel, where the rubber webbing can be attached, the latter being secured to the leg by adhesive strips, in such manner that the contraction of the rubber draws the foot in a direction opposite to that maintained by the deformity.



Underneath this spiral plaster, we frequently adjust a sole of leather, *hammered very hard*, and cut a little larger than the foot, to prevent the plaster, as it is applied around the foot, from impinging upon it too severely. At other times we have applied the rubber to a closely fitting boot, using that as an attachment to the foot.

Dr. Prince, of Jacksonville, Illinois, in his paper read before the State Medical Society of that State, in 1864, has given an ingenious plan for holding the foot, for the purpose of affixing apparatus for removing the deformity.

When the patient walks, we have the whole force of the muscles, together with the weight of the body, tending to throw the foot and ankle into the old abnormal position, and hence the great importance of forcibly holding it in the correct position, and obliging the muscles to conform in the direction of their contractions to the new order of things. The deformed part *should never be allowed to assume its old position*, as it not only is so much time lost, but it is doing work in the wrong direction, that we shall have to undo by artificial muscles.

A point of resistance to these artificial muscles can be secured by attaching adhesive plaster to the limb above, in some one or more of the forms exhibited in the cuts given for this purpose. Any combination can be made, or the direction of the force changed, in a given case, as the judgment of the surgeon may dictate. We desire more particularly to give the principle (with a few illustrations), which every surgeon can apply to any particular case. If a man has not mechanical ingenuity sufficient for this, it is not advisable for him to attempt treating this class of cases. We point out the plan, but leave the details to the ingenuity of the surgeon.

The surgeon will find his labors much reduced by confining his patient to the bed or couch until the foot has become pliable under the process of continued extension (by means of the cord, pulley, and weight), thereby relieving the tension of the muscles and of the bony structure implicated.

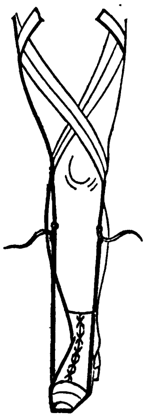
We have seen a case of simulated talipes varus, the result of luxation of the hip-joint, which occurred in infancy. The limb was shortened by the dislocation two inches and a half, and in the act of walking, the foot rested upon the ground upon its outer edge and the toes of that side. This had continued for fourteen years, and the patient had lost *all* voluntary control of the muscles whose office it was to restore it to a natural position.

It amounted to a case of congenital club-foot, the muscles and ligaments being shortened on one side, and correspondingly lengthened on the other. After the luxation was reduced, the foot was treated for talipes varus, upon the principles above enunciated; and in three months time, the patient had not only a good hip-joint, but a straight foot, the toes of which she could raise, by an effort of the will, two inches from the floor, the heel remaining down.

In this case, we had the same pathological condition that exists in paralysis, and the same position of the foot that belongs to talipes. May not this be the fact in some congenital cases?

TALIPES EQUINUS.

We give a cut showing *one way* of applying the adhesive plaster and rubber webbing for counteracting this deformity. A double purpose, however, will be effected, if the counter extension is made over the contracted muscles, viz., the calf of the leg. This can be done by a splint upon each side of the limb, the adhesive straps terminating on each side, near the ankle, and secured to the splints. This will resist the downward draft upon the splints, while they can be prevented from pulling forward at the top by a wide, strong band passing back of the limb, and secured to these. The rubber is secured to the top of these splints and to the foot, as represented in the cut.



Dr. Barwell of London uses a tin, moulded to the limb, for the same purpose. The Dr. in his work, and in his first published papers, overlooks the fact, that we had *promulgated this principle and practised it for many years previous to his adopting it.* As we have before remarked, *we have developed principles*, and shown their applicability, and it is but justice that we should receive the credit.

TALIPES VALGUS.

In addition to overcoming the contraction of the muscles, the arch of the foot should be permanently supported by a metallic sole in the shoe, that shall exactly fit the bottom of a normal foot of the same size. This sole should be worn until the ligaments and soft tissues conform to its shape, while at the same time the patient should avoid stepping upon the foot when without this support.

TALIPES CALCANEUS.

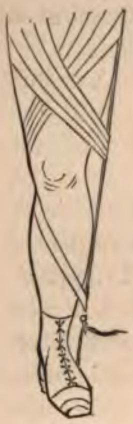
This is the most difficult form of talipes which the surgeon is called upon to treat, as it is almost impossible to adjust and maintain apparatus which will meet the indications

We should attach a steel sole to the shoe, with a projection passing some distance beyond the heel, like a horseman's spur.

Having adjusted firm attachments of adhesive plaster around the upper part of the tibia, to which is fastened a strong rubber webbing, the lower end of this counter-extending artificial muscle should be fastened to the end of the steel projection at the heel. This will subserve the purpose of overcoming the contracted muscles involved, and of educating the elongated ones to contract, by exerting upon them passive exercise, and thereby directing through their proper channels the nervous influence designed to restore them, subject to the power of the will.

Success depends, of course, upon the existence of paralysis of the muscles, and not upon any organic derangement of them. Where there is arrest of development of the bones, we cannot expect the favorable results which would otherwise ensue, if no such malformation were superadded to the contracted and elongated muscles and ligaments. The general principles we have advocated here are applicable to all forms of talipes, and we leave their application to the ingenuity of the practitioner.

The accompanying cut shows one way of sustaining the foot when the muscles and ligaments allow it to turn at the ankle. It can be applied upon either side of the limb. These fixtures *are not elastic*, but are designed to sustain the foot in place of irons. They are vastly superior, as they leave the motion of the foot perfectly free.



It will hardly be necessary to say that, in all cases, the adhesive plaster should be secured to the limb by well-applied bandages. It will be found rather difficult to maintain a roller bandage in its place, when any considerable portion of the limb is covered with the plaster, its surface being so smooth from the glazing applied to the cloth. To remedy this, we have rubbed the plasters on the limb with gum-acacia mucilage, or with simple flour paste, then applied the bandage immediately. This makes the bandage adhere to the plaster and also together; or a more simple and perhaps more efficient plan is, to sew a piece of muslin around the limb in place of the roller. It is not so liable to slide down.

DEFORMITIES.

DEFORMITIES OF THE UPPER EXTREMITIES.

Deformities of the upper extremities may be either congenital or acquired, being the result of various kinds of accidents and diseases, particularly burns and paralysis; and on account of their greatly impeding the exercise of the functions of the member, as well as greatly marring its symmetry and beauty, afford opportunities for surgical interference.

The usual malformations met with in the upper extremities, are redundancy or deficiency of parts, a webbed condition of the fingers, and organic contraction of the muscles and palmar aponeurosis, constituting a variety of distortion analogous to club-foot.

Sometimes one or two fingers are entirely wanting, or are so stunted as to give the hand a very ungainly appearance; and a deficiency in both their number and size may occur, the fingers being all very short and stubby on account of the absence of a phalanx in each, being also joined more or less by thick webs. Sometimes there will be only two fingers with the thumb, or only one, as has been met with.

It is not very rare to find examples of a supernumerary thumb, and occasionally of a finger, and cases are on record in which each hand had a supernumerary thumb, and each foot a supernumerary toe; and such may be hereditary. When an extra finger exists, it is generally connected with the little finger. The superfluous member is usually considerably smaller than the normal one, and well shaped and furnished with a good nail, but occasionally it is bulbous, knobby, curved, and irregular.

In most cases it is attached through the medium of a separate joint, having a distinct synovial membrane, but the attachment may be simply cutaneous.

Great deformity and inconvenience is liable to attend permanent contraction of the thumb and fingers from burns, rheumatism, paralysis, or some congenital vice.

The distortion may be caused simply by a contraction of the tendons of the palmar aponeurosis, or a cicatrix—or all these structures may be simultaneously involved, and may exist in various degrees.

The contractile tendency of the inodular tissue left by burns and scalds is often known to resist the most ingenious efforts on the part of surgeons to overcome, and it usually results in the worst forms of distortion.

The fingers, from paralysis, are frequently permanently flexed, in consequence of the shortened condition of the tendons of the flexor muscles, while the extensors are elongated and completely deprived of their power to counterpoise.

Cases in which the shortening has been occasioned by rheumatism, if existing in an extreme degree, will not be very amenable to remedial measures. There will be a better prospect of affording relief in proportion as the case is milder and more recent. When the acute symptoms of the disorder have abated, an attempt to break up the adhesions within the joints may be made, to restore the contracted muscles to their proper length.

Experience shows that when the deformity is the result of permanent shortening of the muscles or tendons, without regard to its cause, tenotomy is of doubtful utility, as, although the operation may relieve the distortion, yet the patient never regains any material use of the member, but, on the contrary, is generally made worse by the section.

Therefore this procedure should not be had recourse to, in cases in which nearly all the fingers are implicated, as the ends of the divided tendons usually refuse to unite.

Where an unsightly and inconvenient deformity of only one finger exists, there is no objection to the operation for the purpose of remedying the appearance.

There is a great difference between the results of tenotomy of the hand and fingers, and tenotomy of the feet.

In the hand, fingers, and forearm, there is rarely, if ever, perfect reunion after tenotomy, and the consequence is that the operation, so far as restoring the functions of the member is concerned, is a failure; whereas, in cases of tenotomy upon the feet, the ends of the divided tendons always unite with promptness.

This difference is supposed to arise from the existence of a larger amount of synovial fluid in the sheaths of the tendons of the upper extremities than in those of the lower, and the greater extent to which the divided ends of the tendons separate in the upper than in the lower extremities.

In cases of deformities dependent upon contraction of the palmar aponeurosis, the usual plan of treatment is free division of the retracted tissue subcutaneously, and much depends upon the after-treatment in maintaining the hand in proper position and keeping up passive motion.

The deformities arising from contraction of cicatrices, occasioned by burns and scalds, seldom admit of satisfactory relief. The usual plan of remedying such is by exsection of the cicatrix, and supplying the place by ingrafting new and healthy tissue from the arm, chest, or other locality.

Occasionally distortion of the hand occurs, presenting an appearance analogous to club-foot, of the variety called varus, and is hence called club-hand. This may be congenital, but in the majority of cases is the result of paralysis, or loss of antagonism of the two classes of muscles.

Contraction of the brachial aponeurosis and the tendon of the two-headed flexor, in consequence of paralysis, burns, or rheumatism, may render the elbow-joint useless. To remedy this, continued elastic extension may be employed, connected with an angular splint united by hinges.

It has long been a well-established fact, that to divide the cicatrix from a burn, and then retain the parts separate until the space is filled with new material, utterly fails of obtaining any satisfactory result. The new material is sooner or later absorbed, and the edges of the wound in the old cicatrix eventually come together again, leaving the parts as before the operation. In view of this result, surgeons have been in the habit, when practicable, of entirely removing the cicatrix, and of supplying its place with healthy skin from the most convenient locality.

In the plan of treatment we propose, this operation will be simplified, in those cases where for any reason it is resorted to; in others, where it is only desirable to remedy the inconvenience arising from the contracted condition of the parts, without any attempt to remove any unsightly appearance arising from the scar, the operation will be avoided. In carrying out our plans, we are very much aided by the facility with which the skin can be elongated.

Whether the cicatrix is to be removed or not, we apply to the sound skin adhesive straps, through which we can effect continued extension. In some instances, we draw the skin on both sides towards the cicatrix; in others it may be necessary to act only upon one side, gaining all the new skin from one direction. The reader will perceive that this is but another application of the principle we have discovered, of elongating the soft tissues by continued elastic extension. If the malformation is of the hand or arm, the extension can be made by a weight attached to the hand or arm, to be carried during the day, the arm being kept pendent; during the night, the extension can be made through a cord, pulley, and weight, or by rubber webbing. When the contraction is upon the side of the neck or under the chin, the skin from below must be put upon the stretch, and thereby gain sufficient skin to relieve the tension, or to admit of the removal of the offensive cicatrix. The precise way of effecting this in every case would require much time to explain; it must therefore be left to the judgment of the surgeon to apply the principle. If the case is one with an exposed, unsightly scar, of which the patient is desirous of being rid, the surgeon, by first accomplishing all he can by extension, may be enabled to supply new material for the balance, when it would be impossible, were the parts not partially relieved by the elongation of the surrounding skin. It enables him to succeed with a much smaller amount of new material from some other locality, than he otherwise could.

In many cases, this preparation would enable him to bring the parts together, after the removal of the cicatrix, without any new material.

DEFORMITIES FROM PARALYSIS.

Deformity from this cause is more frequent in the upper than in the lower extremities. If the individual is able to perform locomotion, gravity serves to keep the healthy muscles elongated; whereas, if the same person were confined upon a bed, the limb would be drawn up by the contraction of the healthy muscles, and there being no force to take the place of gravity in overcoming the contraction, the limb remains in this position, and, if left, there ensues a shortening, not only of the muscles, but of all the soft tissues, conforming thereby to the altered position of the limb. Elongating these soft tissues again will be of no avail, unless we restore the use of the paralyzed muscles, or counteract the power of the healthy muscles by some artificial means.

If, for instance, the extensors of the hand are paralyzed, and the flexors have closed the fingers down upon the palm, we should accomplish nothing by elongating the flexors and leaving them, as they would immediately resume their former labor of bringing the fingers back to the position they occupied before extension was applied.

There is a material difference, so far as regards the treatment and its results, between paralysis occurring in early childhood, and paralysis commencing in adult age. This difference has not been recognized by the profession to our knowledge, yet it is one that controls our treatment and modifies its results. An adult may be paralyzed upon one side of the body, and in a few months it may pass off and the person go on to a perfect recovery of the nervous influence, and control of the will *over all the muscles.* On the other hand, if a child, during dentition or severe bowel complaint, becomes paralyzed, admitting that in both cases there is the same amount of difficulty, that the brain and spinal cord in both instances are fully and perfectly restored in a given time, the adult recovers the full use of *all his muscles*, whereas the child, if left to himself, will never use the arm to any useful extent. In his efforts to move about, he will perhaps acquire the power of lifting and throwing the limb forward by a motion of the pelvis, and when the knee is back, as in using an artificial limb, will throw the weight of the body upon it when walking; some do not go as far as this in the recovery of the use of the muscles, although the majority, by the constant watchfulness of the mother and friends in training them to make an effort, and in instructing them to direct their will and concentrate their attention upon a particular motion, are eventually able to control the action of a portion of the muscles during locomotion.

The difference between the recovery from paralysis in the adult, and an equal paralysis in every respect, in the young child, appears to be owing to this difference in the two cases: The adult *before paralysis had a perfect use of his muscles for all the ordinary requirements of life; he had so formed the habit of moving certain muscles for the accomplishment of certain purposes, that he was not conscious of exercising any act of volition.* In walking, for instance, he raised his limb by contracting the flexors, moved it forward by contracting the extensors, then threw the weight of his body upon it. This he did without at every step bringing the will into exercise, to act upon certain muscles in a certain way; he did it, as it were, from habit. When such individuals are recovering from paralysis and attempt to move their limbs, the force of habit controls them, and they attempt to move them in conformity to its requirements; they contract all those muscles that they have been in the habit of contracting to perform a certain act. This they attempt, notwithstanding they may not have so far recovered the control of the muscles as to be able to accomplish it. When they *attempt* a given motion, they bring into action the same muscles and in the same order they did before they were paralyzed, although the power exerted by them may be very feeble. If an attempt is made to raise the limb to step, it will not be done by raising the pelvis, while the limb is left hanging listlessly from it, but they will try to do it by the flexor muscles; if these do not respond, they stop there, they do not attempt to do it by raising the pelvis. This is done without reasoning upon the subject, but simply because the habit had before been formed of raising the limb in this particular way.

In young children, the first efforts at locomotion are very different. With them, when they have so far recovered as to be able to stand upon the healthy limb, and wishing to move a step or two, the paralyzed limb feeling like a dead weight hanging from the pelvis, they will attempt to drag it after them. If there is no inconvenience from this process, it will be the extent of their efforts; but if from some uncomfortable sensation or some inconvenience, or should they wish to pass it over some obstacle, they will attempt to raise the limb, and this will be done by raising the pelvis upon that side. The next time they do it in the same manner, and so on until this way becomes habitual; it becomes their mode of locomotion. The ordinary mode of lifting the limb by the contraction of its muscles had not so fixed the habit as to control them in doing it after their recovery from the paralysis. This might not be the result if a child was restored instantly; the perfect restoration of their power of locomotion might bring with it a disposition to move the limb by the usual method; but the restoration being gradual, and the first attempt to move it being made before they have the power to do it by the ordinary contraction of the muscles of the limb, they will effect the movement *by those muscles over which they have control.*

If we have been successful in distinguishing the results of paralysis in the two classes, and in showing why young children do not so readily recover the use of paralyzed muscles as adults, it will be apparent that we have much more to do and many more hindrances to encounter in restoring young subjects, than adults.

In young children, the ability to direct, through the will, the nervous influence to the paralyzed muscles, is lost. Although there may be no organic difficulty, yet they cannot influence the paralyzed muscles; the brain has, as it were, ceased to recognize these muscles as a part of the system. We have the same condition in the muscles of the ear in the adult; the muscles and nerves are there, yet from the entire neglect and disuse of them, we have no power over them. Hence, in endeavoring to restore the use of paralyzed muscles in a young child, we have this serious difficulty to overcome, one that, at first, would appear a fatal barrier to any progress. We have labored an hour with an adult, before he could find how to affect, in the slightest degree, the deltoid muscle, that had been paralyzed from childhood. Being able to use the arm for all purposes without this muscle, he never had directed his attention to it, or made an effort for its restoration. The great difficulty in these cases is to accomplish the first step; to contrive some movement or process by which the patient shall contract the muscle, though it be in the feeblest manner, and without his being aware that he has done it. This can sometimes be done by combining that motion which any particular paralyzed muscle would effect, with some other, in which the muscles that perform it are not paralyzed. This can be done where certain muscles act in groups, or in combination to effect a certain object.

Another mode which we have found very effectual, and which we were the first to bring to the notice of the profession, is, the application of an artificial muscle to take the place of the one paralyzed. The advantages of this application will be manifest when we explain the process. To illustrate its effect, we will take the simple case of paralysis of the flexors of the foot. The extensors have drawn the heel up and the toes down. If we request the patient to turn the foot up, he not only is incapable of doing it, but actually feels that he cannot make the attempt. It will be remembered that we are considering a case where there is no organic difficulty, nothing to prevent communication from the brain to the paralyzed muscles, but simply a loss of connection by disuse. In this case, if we place upon the limb rubber webbing, secured to the limb in such manner that, when left to its contractile power, it will flex the foot, we have an artificial muscle that will bring the foot up whenever the extensors are relaxed; in order to effect this relaxation, we direct the attention of the patient to the foot and request him to turn the toes up. In making the attempt, they cut off the nervous influence from the *extensors;* this leaves them flaccid, and although the patient may not contract the *flexors*, yet the toes and foot turn up by reason of the elasticity of the rubber webbing, and the act is performed at the same time it would have been had the patient done it by an act of the will exerted upon the flexor muscles. Although the patient is under a mistake, in supposing that he has acquired control over his muscles, yet it is an advantage beyond the encouragement derived from it. He has actually performed a part of the natural process of raising the toes and foot by an effort of the will, viz.: he has let go, or relaxed, the extensor muscles, at the same time they would have relaxed, had the flexors contracted and performed their part of the process of raising the toes. By continuing this exercise, with the mind of the patient directed to the foot, he will eventually find the muscles obeying the will, and the exercise increases their nutrition at the same time. The great object of the artificial muscle being to show the patient when he makes the *right effort*, whereas, without it, he could not have distinguished between a right and a wrong effort. It also demonstrates each time whether he has been successful, without the presence of the surgeon. This fact is of the utmost importance, as it enables the patient to continue the exercise correctly when left to himself. Again, the satisfaction arising from the assurance that he is accomplishing what he attempts, is a strong encouragement to repeat it, whereas, without the artificial muscle to move the parts in place of the flexors, there would be no result from an exercise of the will, even though it had been correctly directed.

By the application of artificial muscles in the manner described, the surgeon can overcome the *disuse* of any muscles, when the nervous influence is not interrupted from an organic cause. It is simply to a disuse of the muscles that this treatment is applicable, although paralysis may be the primary cause. We sometimes combine, with an effort to move paralyzed muscles, the use of the same muscles of the other limb, acting in concert, moving the paralyzed limb with our own hand, keeping the attention of the patient directed to the paralyzed part, cautioning him to make an effort at each movement.

GENU-VALGUM, OR KNOCK-KNEE.

THIS deformity arises usually in delicate weakly subjects, from infancy to the twentieth year, especially in those patients affected with rachitis and scrofula, and is particularly liable to occur in the negro. The knees, where both are implicated, turn inward, and, in standing still, brace against each other, while the legs incline outward at a considerable angle, resting upon the inner margins of the feet, giving rise to double Talipes Valgus, with considerable separation of the feet from each other. This condition of the limbs very materially impairs the appearance, and greatly interferes with the facility of locomotion, the patient limping along with a very awkward gait.

Knock-knee was at one time supposed to be an intra-uterine or congenital deformity, but that idea is now generally abandoned. It is liable to occur in both sexes, from over-exertion, as in lifting, when there is an enfeebled, relaxed condition of the internal lateral ligament, allowing the external ham-string muscle, in flexing the thigh, to gradually draw the head of the tibia outward away from the internal condyle.

The semi-membranosus and semi-tendinosis, forming the internal ham-string muscles, soon become relaxed and elongated, allowing their antagonists to exert their powers of contraction more and more, and thus increase the deformity which, in aggravated cases, involves changes in the natural relations of the crucial ligaments, curvature of the bones of the leg, attenuation and stretching of the internal ligaments of the ankle-joint, and contraction of the peroneal muscles, together with flattening of the foot and eversion, as in cases of Talipes Valgus.

Professor Bock, of Copenhagen, arranges the deformities of the knee-joint under the four following heads:—

1. Contraction of the knee (*Contractura Genu*) is the name given to the condition in which the knee is in a state of abnormal constant flexion, with limited power of motion in the joint.

2. Recurved Knee (Genu Recurvatum). Here the knee is in a state of super-extension, and the popliteal space forms the apex of an angle pointing backward.

3. Genu-varum, or Bow-leg, called by the Danish wheel-leg (Hjulbenet).

4. Genu-valgum, or Knock-knee; in Danish, calf-knee (Kalveknaet); in German, Goat's-leg (Ziegenbein) X-leg (X-bein).

Professor Bock states that, in Genu-valgum, it is not the knee but the tibia which is pressed outward; and the more correct denomination would be therefore Tibia Valga, if the analogy with the foot were preserved. The same will apply to Genu-varum. Where the disease has commenced in youth, a curvature of the spinal column will generally be produced by the obliquity and the lameness. The affected limb is usually more or less atrophied. Prof. Bock professes to have met with two cases of anchylosed knock-knee in elderly persons: in these the limb was also directed backward. Prof. B—— holds that there is almost as frequent complication with club-foot in cases of knock-knee, as with flat-foot and eversion with treading on the inner margin causing callosity, and, as the shortness of the limb leads the patient instinctively to endeavor to touch the ground with the points of the toes, it is evident that the other complications of deformity will be attended by a greater or less degree of Talipes Equinus.

It has hitherto been impossible to determine the reason why these secondary deformities of the feet should in some cases assume one form, and in others, another.

In certain peculiar cases, the deformity of the knee is secondary. A patient in Dieffenbach's ward had had, from childhood, *Cyphosis Accurvata* of the lumbar vertebræ; in his youth, varus had been developed in both feet, and, in his sixteenth year, he had become knock-kneed in both legs. Sometimes there is Genu-valgum on one side and Genu-varum on the other, accompanied by corresponding or distinct deformities in the feet.

The greater convergence of the thighs in women might be supposed to be a predisposing cause, and Lessing says that this affection is more frequent in females than in males.

Prof. Bock, however, says this is incorrect, and that this deformity is twenty times more frequent in males than in females, and he also concedes that scrofula and rickets are the principal predisposing causes, especially the latter, which still more frequently produces Genu-varum, in which case the external condyles of the femur and tibia are most affected and enlarged, while a similar swelling of the internal condyles gives rise to Genu-valgum.

Genu-valgum is considered by Prof. Bock as a disease of a paralytic nature, and as a general rule its most usual causes those arising from a depressed state of innervation, and hence the commencement of the affection is limited to certain periods of life in which the nervous centres undergo a more than ordinary degree of disturbance, connected with the state of development.

Prof. B—— thinks that Genu-valgum is developed either during the first dentition, or during puberty, and he considers the rule so constant that the only exceptions are the cases in which some local malady has given rise to the deformity, but the latter are comparatively rare. In children, the disease has always, in Prof. Bock's cases, arisen between the eighth month and the completion of the second year, and has always been preceded by difficult dentition, with fever, convulsions, violent whooping-cough, or, as in one case, acute exanthematic fever. This agrees with what has been stated by Heine with regard to nine cases of knock-knee observed by him.

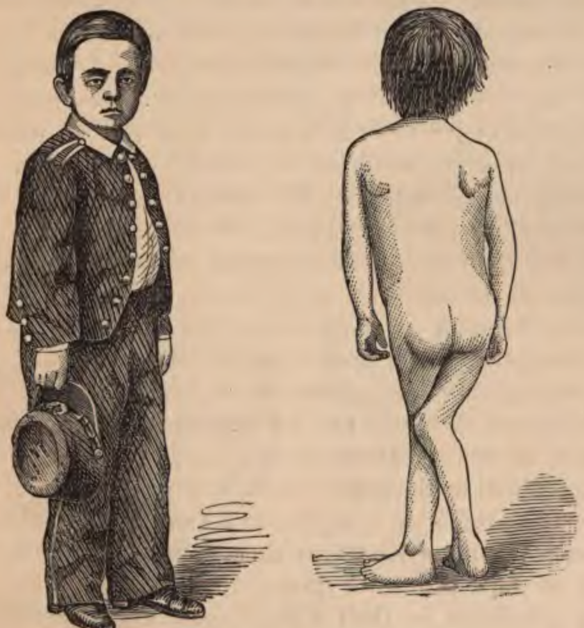
The external causes which may give rise to the affection at this age, and under the circumstances which have been mentioned, are, that the children *walk too early*, or too soon after a weakening illness before they have yet recovered strength, or, that they are habitually carried on one arm, by which one knee is pressed inward.

In both variations from the normal positions of the lower limbs, whether the knee is thrown outward or inward, the limb should be extended until the ligaments elongate on the concave side and shorten upon the other. This can be done in the shortest time and most readily by placing the patient upon a bed or couch, and applying the weight. My own advice would be, to continue this position until the limbs are straight, and then use passive exercise, afterwards directing the patient to exercise the limbs, without at the same time supporting the weight of the body, obliging him to flex and extend them always correctly. After a longer or shorter time, he may be allowed to walk across the floor, provided always he can retain the limbs in their normal position; but never to walk, unless he can do this. When the muscles begin to yield from the exercise, it should be stopped until they recover their tone.

There is generally an altered condition of the condyles in this difficulty, and the patient should not stand upon the limbs much until this difference has changed to the natural form.

If these precautions are not taken, the old habit will return, and all the labor of the surgeon and patient will be lost.

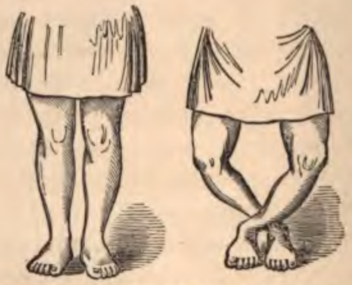
We have seen this distortion of the limbs produced in young males of animals from excessive venery. This led us to suspect it as a cause in a lad of nine years of age (see cut) whose limbs were so distorted, that the patella in both limbs was outside the condyles, and the tibias ro-



tated outward upon the outer condyles. The latter were flattened by absorption; the ankle-joints were necessarily distorted in conforming to this position of the tibias, the latter projecting at an angle of forty-five degrees.*

This same condition of the limbs we have had from distortion of the femurs in cases of rachitis.

Apparatus can be used to keep the limbs in position, but we prefer to effect a cure without their aid. The patient and friends are very apt to throw the responsibility of retaining the limbs in a correct position upon the fixtures. The result is, that as the apparatus yields, by wearing or any other cause, the limbs conform to the change. There can be no radical cure unless the muscles and ligaments perform their functions correctly while the limb is in a normal position, and the best way is to *compel* them to do it, making it a condition of the patient's walking that he shall walk correctly, or he must be confined to the bed. We have used a splint upon the side of the limb, with a joint at the knee. This is placed upon the concave side, and the limb brought up to it by rubber webbing laced around the splint and the knee. If this is properly attended to it will secure the result, and can be trusted upon an adult patient, who is desirous of recovering, yet cannot be confined, as is necessary, when without apparatus.



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* This lad after some time confessed that he had practised masturbation for a long time, that he learned it from an older boy.

LATERAL CURVATURE OF THE SPINE.

Curvature of the spine may occur in either of three principal directions: first, backward; second, forward; and third, laterally.

The lateral curvature of the spine is a very different affection from the antero-posterior curvature, which is in fact not a curve, but an angular distortion, in which latter the deviation is dependent upon organic disease, leading to destruction of the osseous bodies of the vertebræ themselves; but the lateral distortion may arise from various causes.

Among the causes of lateral curvature may be mentioned malformation of the vertebræ from defective development —some of the individual pieces being either too small or too large, or so united as to meet only at particular portions, instead of at their entire surfaces—in consequence of which the muscles of the spine, in their efforts to maintain equilibrium, soon act unequally, some on one side, overpowering their opponents on the opposite side, but not always uniformly, and thus giving rise to the worst forms of distortion.

Lateral curvature of the spine is a frequent result of rachitis, the bones of the spinal column being so weak as to be incapable of withstanding the action of its several muscles. This disease is almost peculiar to early childhood, and consists in great deficiency of earthy salts; in consequence of which the several pieces of the skeleton are rendered so soft and flexible as to admit of being cut and bent in almost any direction.

The bones entering into the formation of the spinal column being equally liable with the rest of the osseous system to the changes peculiar to rachitis, it is very easy to understand how the symmetry of the vertebræ may be impaired, through muscular contraction acting upon softened and yielding bony attachments. Sometimes the spine is drawn not only sideways, but backward, producing in this manner some of the very worst examples of this curvature.

Altered capacity of one side of the chest, giving rise to ascendency of the muscles of one side over those of the other, and producing spinal curvature, is exemplified in cases of chronic pleurisy and empyema, in which, on account of the compression and obliteration of the bronchial tubes, and the extensive morbid adhesions which are liable to result between the pulmonary and costal pleuræ, the ribs may sink in and lie almost in contact with each other, thereby greatly diminishing the capacity of the thorax of the affected side, while the capacity of the healthy side is correspondingly increased.

Obliquity of the pelvis, from injury or disease of the lower extremities, is invariably followed, if long continued, by lateral curvature of the spine, especially in the lumbar region, an exemplification of which is presented in diseases of the hip and knee-joints, in which the effort to throw the weight of the body upon the sound limb elevates the pelvis of the affected side, and a curve is formed in the loins by the constant strain upon the muscles of the spine.

General or local debility of the muscles is a very frequent cause of spinal curvature; in the former, affecting the muscles generally; in the latter, chiefly those of the spine.

Whatever causes tend to depress the vital powers must necessarily weaken the muscular system and lead to irregularity in their contractions, and thereby disqualify them for the proper performance of their functions. Protracted fevers and exhausting discharges have been known to occasion debility eventuating in lateral curvature of the spine; and similar effects have been traced to unwholesome food, starvation, inadequate clothing, and other causes producing an impoverished and anæmic condition of the system; the patient finding, upon recovering from the debilitating causes, that the muscles of the back are too feeble to sustain the spinal column in the erect position, and that, therefore, in his efforts to walk, the spine is drawn toward the side upon which the muscles exercise the greatest contractile power.

Fatigue of the muscles of the back, from protracted standing, or otherwise sustaining the spine in the erect posture, as well as arrested growth of the muscles, from the use of corsets, are among the more common exciting causes of local muscular debility, resulting in curvature of the spine; and other examples of the same nature may be found among children who are obliged to sit daily for a number of consecutive hours in school, upon seats without proper support for the spine, and also among young female operatives in crowded factories; the effect of which is, that the erector muscles of the spine, being constantly kept upon the stretch, soon become exhausted, and, by the frequent repetition of this strain, ultimately become entirely inadequate to the performance of their duty.

The consequences of this practice are more especially pernicious, if the child happen to be naturally feeble, or if he has become debilitated by disease, the spinal column in such cases being not only distorted laterally, but twisted more or less upon its axis.

As regards the injurious effects of tight lacing, they are well known to every surgeon, not only in their relation as the cause of spinal curvature, but in their influence upon the general health. If the practice be persisted in for a long time, the muscles of the back, being seriously restrained, become irregular in their action, atrophied, and unfitted for the proper discharge of their respective functions, those on one side overpowering their opponents, and dragging the spinal column out of its natural curves.

Various conditions of the muscles have been noticed as causes of spinal curvature. Often the excessive use of one set of muscles, as of the right arm, in blacksmiths, dragoons, and others, will so develop them, in conformity with the well-known law, that muscular tissues develop and enlarge in proportion as they are exercised, as to induce hypertrophy of them, especially as compared to their fellows of the opposite side, which will necessarily result in loss of equilibrium, the stronger set of muscles overpowering the weaker; and, therefore, in proportion as this preponderance of action exists on one side, will the spine, if the muscles so enlarged are attached to it, be drawn over toward that side. The trapezius and rhomboid are the muscles most liable to excessive development from this cause, and, acting directly upon the spine, overpower their fellows of the opposite side, thus producing marked curvature of the spine, the convexity of which corresponds to the side upon which is the hypertrophied arm.

A similar result may ensue when the muscles of one side, attached to the spine, become atrophied, while those of the opposite side retain their normal healthy condition; the balance between them, as in the former case, being lost, the spinal column is liable to more or less displacement.

Spasmodic contraction of muscles attached to the spine, when existing in a high degree, as in wry-neck, produces more or less distortion, and, in the last-mentioned form, the muscles may produce extreme curvature of the cervical vertebræ.

The degree to which the curvature of the spine may proceed from these different causes is variable, being limited to one particular region, or involving various portions, or even the whole length of the spine. In cases where the affection is very extensive, there are generally compensating curves—one or more curve on each side.

Sometimes, as in cases of paralysis of the muscles on one side, one continuous curve exists on the other side. This is termed a sigmoid curvature, and can never rectify itself, because it is impossible to establish a counterbalancing power in the congenerous muscles.

Marked rotation of the spine always attends the more aggravated states of lateral curvature, the rotation existing in the direction of the convexity of the curvature. In proportion to the degree of the lateral curvature, so is the length of the spine diminished; the ribs are flattened, elongated, and twisted, and the sternum and costal ribs are depressed forward toward the pelvis. The scapula on the side corresponding to the convexity of the spinal curve is abnormally large and elevated. A cervical curve gives rise to obliquity of the head, and a lumbar one to obliquity of the pelvis.

The curvature is usually effected in the earlier stages of the affection, at the expense of the intervertebral cartilages and ligaments; but, as the distortion advances, the bones themselves become involved in the disorder, some portions being absorbed, and others increased by the deposition of new osseous substance. The reasons why this change is effected will be given fully in another place.

In lateral curvature of the spine, the *symptoms* are those denotive of the functional derangement of the abdominal and thoracic viscera, according to the extent and duration of the distortion. In the mild cases, the patient is merely inconvenienced in walking, becoming easily fatigued during exercise, and suffering from occasional palpitation of the heart, and perhaps some degree of uneasiness in breathing.

The general health begins to fail gradually, and the effort to maintain the erect position during walking and sitting becomes more and more tiresome; derangement of the stomach is apt to supervene, with constipation of the bowels. Pains occur in the side and back. In the female, dysmenorrhœa is often present, and the countenance is pale, care-worn, and exhibits a chlorotic appearance.

In many slight cases of lateral curvature, the health suffers little or nothing; the local symptoms may be principally those of which the patient complains, as pain in the right shoulder, fatigue on making slight exertion, interference with the respiration, after a while, as the distortion increases, with altered size of the thorax; palpitation of the heart from the same cause, as well as from its mechanical displacement and compression; disorders of the digestive and other organs, both primarily produced by the deformity, and secondarily through failure of the general health and strength.

One symptom may be particularly mentioned, namely: a constant pain in the left side, in cases which have progressed, the pain being referred to the left side, just below the ribs, which it is difficult to relieve.

In more than one instance, this has been traced to the existence of incipient curvature of the spine, and the question has been asked if it may not depend on the pressure against the viscera, caused by the altered position of the ribs.

A slight degree of lateral curvature of the spine, on the right side, exists in almost all persons, in consequence of the right arm being naturally so much more used than the left, but not usually to such a degree as to constitute a morbid affection. As a disease, it is most commonly observed in young girls, from five to eighteen years of age, particularly in those of a feeble constitution, congenital, or as the result of exposure to hardships, especially to want and destitution. Also in the children of the wealthy, who are pampered and indulged in scenes of excitement, exhausting the brain.

As long ago as 1837, Dr. John B. Brown, of Boston, published a series of letters in the *Boston Medical and Surgical Journal*, in which he severely animadverts upon the rigid discipline of schools which confine young misses for four or five hours consecutively, upon seats constructed too high from the floor to allow the feet to touch, and with no support to the back. The muscles of the back, under such circumstances, soon become tired, and the child, to relieve them, inclines to one side or the other, and from this generally gets into the habit of inclining to one particular side, the right or left.

The spine, as a natural result, acquires a curve in the opposite direction, one shoulder-blade projects, and one hip is more elevated than the other.

Another cause of curved spine, not unfrequent in public schools, is the desks on which children write, which are not always adapted to the height of the pupil. And in the case of children compelled to write two hours per day on a desk from four to six inches too high, the right shoulder must necessarily be elevated, the scapula thrown out, and the spine curved.

Dr. Portal, an eminent French physician in his day, ascribed curvatures of the spine to the pressure caused by the fashion among many of wearing stiff stays. And particular mention of the effects caused thereby on the muscles of the spine, by the constant pressure, is made by the celebrated Dutch physician, Van Swieten.

Many cases of curvature of the spine, under treatment by means of the heavy, cumbrous, and uncomfortable mechanisms of former times, have been aggravated by the means intended for their cure, the tendency of which was to compress the body, interfering with the functions of the skin, and preventing the use and development of the muscles, which were already acting at disadvantage, in consequence of the alteration of their points of leverage.

The consequences of wearing such machines were well described by an author who wrote nearly a century ago:— "Some nations have fancied that nature did not give a good shape to the head, and thought it would be better to mould it into the form of a sugar-loaf. The Chinese think a woman's foot much handsomer if squeezed into one-third part of its natural size. Some African nations have a like quarrel with the shape of the nose, which they think ought to be laid as flat as possible with the face. We laugh at the folly and are shocked at the cruelty of these barbarians, but think it a very clear case that the natural shape of a woman's body is not so elegant as we can make it by the confinement of stays.

"The common effect of this practice is obstruction in the lungs, from their not having sufficient room to play, which, besides tainting the breath, cuts off numbers of young women in the very bloom of life. But nature has shown her resentment of this practice, by rendering above half the women of fashion deformed in some degree or other.

"Deformity is peculiar to the civilized part of mankind, and is almost always the work of his own hands. The superior strength, just proportion, and agility of savages, are entirely the effects of their education, of their living mostly in the open air, and their limbs never having suffered any confinement."

The above allusions tend to show that the bad effects of artificial supports to the human body, when applied in such manner as to impede the free exercise of the muscles, and the confining of the trunk in casemates of armor as cumbrous and impervious as an iron-clad, for the correction of spinal deformities, were appreciated a hundred years ago, but yet in this enlightened age they are still practised by some, in ignorance of correct views and an enlightened sense as to cause and effect.

The object should be, in treating curvatures of the spine, to give physical strength to the muscles generally, and particularly to those immediately implicated in the defect.

Some artificial support is necessary for the purpose of relieving the spine of the weight of the head and shoulders, but no appliances should be allowed to interfere with the free use of the muscles.

In lateral curvatures, the curve usually first forms in the loins, and the compensating curve in the dorsal and cervical portions of the spine follows as a necessary consequence, to enable the body to preserve its equilibrium.

If the curve in the loins can be straightened, it is almost a necessary consequence that the dorsal and cervical portions of the spine will also become straight, upon the above law of compensation; but this will only follow where the dorsal and cervical portions of the spine are sound and healthy. It is, therefore, important to take steps to straighten the lower curve in the first place.

Lateral curvatures are simple or complex. A simple lateral curvature is unaccompanied by disease of the vertebræ, anchylosis, or stoop. A stoop, added to a lateral curvature, renders it complex; a great proportion of lateral curvatures are unaccompanied by a stoop. Old people, girls who are obliged to sit much at work, and young ladies who play a great deal on the piano-forte, are very apt to contract a stoop, and, where this complication occurs, the treatment must be modified. Simple curvatures of the spine may almost invariably be cured, if taken in time; but, when neglected for years, the vertebræ become thinner on the concave, and thicker on the convex side of the curve, which is consequent upon the unequal pressure, the superincumbent body being almost entirely supported upon the edges of the concave side of the curvature. The rational way of treating curvatures of this kind is, to relieve the spine of the weight of the head and shoulders by mechanical appliances, so constructed as not to impede the action of the muscles, and continued until absorption has taken place on the thickened side of the vertebræ, and ossific matter been thrown out on that side which has become thinned by pressure; at the same time making use of appropriate gymnastic exercises for strengthening the muscles of the back, so that, when mechanical support shall be removed, they may be able to keep the spine in its natural erect posture.

Curvatures of the spine come on insidiously, and are frequently unnoticed until they produce a very considerable deformity. The growing out of one shoulder, the elevation of one hip, and the enlargement of one side of the chest, are marks of curvature of the spine, which it would be well for parents to understand, in order that they may apply for proper treatment in time. Whatever causes tend to produce muscular debility also extend their influence to the ligaments, allowing the bones to yield until the ligaments suffer all the strain of sustaining the body; and where the ligaments binding together the vertebræ become unremittingly tense and are excessively lengthened, as a consequence, deformity ensues, and it is a long time, even under the most favorable circumstances, before they recover their natural condition. The contraction of a cyst, after the cure of an abscess of the lungs, may be sufficient to draw the vertebræ out of their proper line, and to bend the ribs inward. Any alteration in the natural form of the skeleton will induce a change in the state of the muscles. In certain cases of club-foot. for instance, the natural fulness of the calf of the leg is wanting; but, as the deformity is lessened, and the muscles are brought into action in their natural relations, the proper development of the muscles ensues. In bad cases of distorted spine, some of the muscles are in the same state as in the legs of persons with club-foot—small, pale or yellow, in a languid state of nourishment, and sometimes subject to a kind of fatty degeneration.

As was observed years ago by Dr. L. J. Beale, there is, perhaps, no notion more pernicious than the supposition that children will outgrow deformities. That a deformity will often stop at a certain point, and, as the body grows, will become less apparent, is a well-known fact; but the instances of a natural cure are so few that all such hope ought to be abandoned, and proper means of cure had recourse to at as early a period as possible—such as mechanical assistance and means which give tone to the faulty muscles.

There is another popular error, namely, that the deforming process will stop with the period of growth; on the contrary, it often happens that the deforming process goes on more rapidly after the growth of the body has ceased, than before, and cases of lateral curvature sometimes commence even long after the growth of the body has terminated, and proceed to a very distressing extent. Usually spinal curvature commences between the ages of eight and eighteen, particularly in those cases resulting from muscular debility, while those consequent upon disease of the ligaments, cartilages, bones, and rheumatic affections, affect persons at all ages.

In discussing the predisposing causes of lateral curvature of the spine, Mr. Edward F. Lonsdale, F. R. S., London, in his work on Lateral Curvature of the Spine, published 1847, after mentioning general debility of the system, producing weakness of the muscles and ligaments—the deficiency in strength showing itself more readily in the spine than other parts of the body—lays considerable stress upon the difference of the pressure internally on the two sides of the thorax against the inner side of the ribs, the left lung containing less air than the right, being smaller in size, while the ribs on the right side receive support also from the liver being pressed against them, causes which he thinks give a predisposition to use the right upper extremity rather than the left, the right side of the chest receiving support from the liver, combined with increased strength and more constant use of the right arm, while the left lung and left side of the chest offer less resistance, and are therefore more liable to the encroachment of curvature upon the weaker side.

Dr. Louis Bauer, of Brooklyn, N. Y., in his introductory lecture of a series delivered at the Brooklyn Medical and Surgical Institute, says that, "with but few exceptions, almost all deformities of the body are of a *consecutive* character; the bones act merely as passive agents in following the traction of the muscles. The latter, in their turn, are subservient to the nervous system, reflecting all the morbid changes that may take place in that sphere.

"If, however, a deformity has become firmly established, and has lasted for some time, both bones and muscles undergo more or less permanent changes in form and texture, and the difficulty may ultimately become irremediable. The ligaments are, by virtue of their structure and function, not as often implicated in deformities as bones and muscles. Sometimes they are compromised in the formation of the sclerotic tissues at the articulations; in paralysis they seem to become relaxed, and therefore facilitate an undue mobility of their respective joints. But a contraction of ligaments is a physiological impossibility.

"Their dimension is regulated by their elasticity. They may lose that elasticity by structural changes. They may become elongated by loss of elastic fibres and excess of fat.

"It can, however, not be conceived how they can become shortened by any other process than sclerosis, and this presupposes local inflammation."

As we have on former occasions been pained at the uncertainty of the Doctor's memory, we will here place our views side by side with his, that he may so associate them in his memory as not to forget himself, and assert at some future time that he has *always* known that ligament lengthened and shortened in the following manner: *Ligament, or any soft tissue, when put under even a moderate degree of tension, if that tension is unremitting, will elongate by the addition of new material; on the contrary, when ligaments, or other soft tissues, remain uninterruptedly in a loose or lax state, they will gradually shorten, as the effete material is removed, until they come to maintain the same relation to the bony structure with which they are united that they did before their shortening. Nature never wastes her time and material in maintaining a muscle or ligament at its original length, when the distance between their points of origin and insertion is for any considerable time, without intermission, shortened.* They change by nutrition, modified by the circumstances under which they are placed.

Further on, in the same lecture, Dr. Bauer, in speaking of paralysis as a cause of deformities, says: "Secondly, but one muscular group may be paralyzed, and its antagonists retain more or less power, and draw the joint to their side."

Subsequently, in speaking of lateral curvature of the spine, Dr. Bauer, with characteristic consistence, repudiates his own statements, as above, and which he lays down as axioms for the unqualified acceptance of the profession, as follows :—

"The doctrine of Delpech, of disturbed muscular antagonism (as a cause of lateral curvature of the spine) is still in vogue, and most orthopædic surgeons base their treatment of scoliosis on that cause. The meritorious and systematic labors of the late Dr. Werner have, however, so thoroughly proved Delpech's theory as inconsistent with physiology, that no well-informed practitioner can any longer uphold it. With the firm guide of Dr. Werner's observations and experiments, we now perceive the fallacy and inconsistency into which Delpech has led us, yet we are inclined to retain a plausible theory in preference to none at all.

"We presume that you are not familiar with the writings of Werner, and hence we may consider ourselves justified in briefly adverting to his deductions.

"The antagonism of the muscular system has been based on the supposition that each muscle or each group of muscles was equally balanced by another muscle or another group, and that the form of the frame depended on the equal power of both. Delpech consistently inferred, from this supposition, that the form was necessarily disturbed as soon as this muscular antagonism was infringed by a one-sided increase or decrease of muscular power; whereas Werner demonstrates that the muscular antagonism is a gross error, and in reality does not exist. In this assertion, his experiments and physiological facts bear him out."

Dr. Bauer goes on to say that Warner's theses tend to prove:

"1st. That there is no antagonism between muscles, as maintained by Delpech.

"2d. That single muscles, and the groups, are unequally balanced, as has already been demonstrated by Borelli.

"3d. That the balance of power is simply subservient to the will.

"4th. That the full measure of muscular power will produce results proportionate to the length, thickness, and leverage under which single muscles, or groups, act, irrespective of antagonism.

"5th. That the muscle, if not actuated by the will, is physiologically at rest.

"6th. That this rest is complete, and not impeded by the so-called muscular tonicity.

"7th. That the muscular structure is endowed with contractile, but not with expansive powers.

"8th. Hence, a contracted muscle cannot expand itself, but requires either the weight of extremity, *or an antagonist*, to regain its full length, to be ready for another contraction.

"9th. The theory that a muscle becomes permanently contracted, and the extremity deformed, when its antagonist is paralyzed, is erroneous.

"10th. During a temporary contraction, the skeleton is drawn in the direction of the healthy muscle; but, as soon as the contraction is terminated, it will return to its original position by its weight, or may be reformed by assistance. Thus, the forearm will extend itself, though the triceps be paralyzed. When the weight does not aid, as for instance, in paralysis of the extensors of the fingers, it requires the other hand. In paralysis of the facial nerve, laughing or speaking draws the face towards the healthy side. In this distorted attitude the face remains, because the contracted muscles, though at rest, cannot expand themselves. But the face can be pulled straight, and will remain so until again disturbed by a new exertion of the facial muscles.

"11th. Permanent muscular contraction necessarily emanates from morbid process, and cannot be regarded as a physiological act.

"12th. A muscle can be at rest, whether extended to its full length or shortened.

"13th. Contraction is inseparable from shortening, but the latter may exist without the former.

"14th. Most muscles combine with their antagonists to effect a motion in a third direction. Thus the flexors and extensors of the foot affect both adduction and abduction."

With this formidable array of propositions, Dr. Bauer claims to have entirely succeeded in routing Delpech's theory of muscular antagonism. According to our understanding, he does not adduce a single argument militating in the least against the principles founded by Delpech; but, on the other hand, many of his propositions tend directly to corroborate them, and even those arguments which he does offer are of a negative character, and not pertinent, but inadvertently corroborating and substantiating the grounds assumed by M. Delpech.

He says: "These numerous facts (?), supported by conclusive experiments and observations, render Delpech's *muscular antagonism* untenable."

Dr. Baur assumes that we "are not familiar with the writings of Werner, and hence we may consider ourselves justified in briefly adverting to his deductions."

Inasmuch as the great majority of surgeons would prefer to judge from an entire translation of the "original Dutch," rather than accept the *ipse dixit* of the Brooklyn professor, we would ask why he did not acquaint us with the "conclusive experiments and observations" with which he seeks to annihilate the doctrines advanced by M. Delpech.

The study of anatomy, especially that portion of it relating to the muscles, clearly demonstrates their arrangement, on each side of the mesial line, in pairs.

Take, for example, the familiar subject of squint, or strabismus, and the arrangement of the muscles of the eye on either side must show conclusively the antagonistic functions which they are made to perform upon the organs respectively. In the case of a healthy eye, if either the external or internal rectus muscle be cut, its antagonist draws the ball of the eye towards the one remaining intact; if both the external and internal recti muscles be cut simultaneously, the eye will remain turned in the direction it assumed at the time of the section, and will retain the convergent or divergent position in which it may be subsequently moved by the fingers of the operator.

Dr. Bauer proceeds to speak of Delpech's theory as follows:

"Its fallacy becomes, however, still more transparent as soon as its practical application is attempted upon habitual scoliosis, for it is utterly impossible, even among the warmest adherents of Delpech's theory, to settle the problem whether the dorsal muscles are on one side weaker or stronger than their antagonists. Nor are they able to decide whether the muscular preponderance exists on the convex or concave side of the deviated spine.

"At any rate, the dynamometer has not disclosed the fact that there is any preponderance of muscular power on either side."

This is very easily understood, when we look at the mechanism of the dynamometer, and see that it is absolutely incapable of throwing any light on the subject whatever, when applied to individual muscles acting in the unnatural position in which the muscles implicated in lateral curvature of the spine have gradually become placed.

If the reader will turn to page 139, and read what we say to the Dr. in reply to what we there quote from his lecture, he will find, instead of theories, physiological facts that are incontrovertible—the same results following the conditions there laid down have never failed in our experience of twenty years. With this result, what would be the form of the face, paralyzed and drawn to one side, as he says in proposition 10th, if it was left undisturbed. Would not the contracted side eventually become permanently so? We have seen, repeatedly, permanent deformity and entire loss of muscular power in certain muscles, by retaining a member in a given position for months. The Hindoo devotees are instances of the truthfulness of our statement. Parts that they retain in any unnatural position for a long time become fixed, and the devotee loses all control over them. Much of this reasoning, from the appearance of parts that have long been in a changed position, is fallacious; in a large number of cases the appearance is the result of the changed position, and not the cause. We have not time to elucidate here the whole subject, but the reader will find under different heads sufficient to answer all of this formidable array of assertions.

Among the causes of lateral curvature, inequality in the sides of the chest is mentioned. This cause was recognized by us more than twenty years since, long before authors had mentioned it. This will be found to be the cause in all cases of lateral curvature occurring before the approach of puberty, when, apparently, it is a muscular difficulty, perhaps we may say, in all cases not dependent upon softening, or deficiency of lime in the vertebra. It is not always that the concavity of the curve is to the diseased side; it sometimes occurs that the increase in size of the healthy side is so great, that the individual is under the necessity of leaning in the opposite direction, in order to support the centre of gravity, like a person carrying a weight upon the shoulder. When the curve is the other way, the projecting of the diseased side compensates.

We cannot quite agree with the statement, that the curve of the spine in hip disease is owing to the weight of the body being thrown upon the sound limb; if the weight of the body were the cause, the pelvis would be raised upon that side, which is the fact in cases of paralysis. The pelvis is drawn up on the side of the diseased joint, although there may be no weight resting upon the well limb. This deformity is owing to the contraction of the muscles, or rather, to an effort to shorten the distance between the origin and insertion of those muscles that arise from the spine, and are inserted into the femur. This can only be effected by drawing up the pelvis.

We have mentioned that, in paralysis of the lower extremities, the weight of the body, when resting only upon one limb, thrusts the pelvis of that side upward. This necessitates a curve of the spine. The same curve takes place when the femur is dislocated into the thyroid foramen, and the patient is examined in a sitting posture; when prone, the curve disappears.

Any cause that places the pelvis at any other angle with the spine, laterally, than a right angle, necessarily produces a curve in the lumbar region, as it throws the centre of gravity of the upper portion of the body to one side of the centre of the pelvis. In order to rectify this, the upper part of the body is brought back, not only directly over the centre of the pelvis, but exceeds this point sufficiently to restore the centre of gravity. These causes are mechanical, and affect the body above the pelvis like sitting with one side of the pelvis lower than the other. The same result takes place in walking upon the side of a hill. As we cannot walk at right angles with the surface, we necessarily lean up the hill, and consequently curve the spine. Curvatures from these causes are distinct and unlike the lateral curvatures that commence as puberty approaches, which are confined almost, if not exclusively, to females, and of which we shall speak more fully hereafter; neither do causes that debilitate or exhaust the vital energies give rise to the true lateral curvature of females, *unless* they occur at this climacteric period or immediately after; there must exist, in addition to the debilitating causes, a constitutional and climacteric condition of the system. These remarks are applicable to the various causes mentioned by authors—such as confinement in school upon badly-constructed seats, the habit of leaning to one side while studying, &c.; also to tight-lacing as a cause. These all act as exciting or abetting causes, but do not produce lateral curvature unless conjoined with the conditions before mentioned. A single uniform curve of the whole spine, we have often seen in the elder daughters of a family, when they have been obliged to take charge of the younger children—carrying them upon one hip, and holding them against the body by the arm of that side. The additional weight upon the hip must be counterbalanced by leaning the head and shoulders to the opposite side, in order to bring the centre of gravity within the feet. If this is continued for months, the spine will be found with a uniform curve from the pelvis to the cervical region, the shoulders being sufficiently to one side of the median line to balance the weight of the lumbar portion that is past the centre in the opposite direction. This curvature becomes permanent, in obedience to the law that the soft tissues, if kept unremittingly tense, will grow longer, while those that remain lax for a long period will not be reproduced of their original length, but conform to the distance between their origin and insertion; after this has taken place, the parts will thus remain until there is some counteracting interference.

There are some facts in the preceding pages, that have not been fully considered, and others that have not even been noticed, by writers upon this subject, which we think are worthy of special attention. We refer particularly to facts in connection with the common form of lateral curvature, commencing about the period of puberty, always, we believe, in connection with it.

In the first place, lateral curvature, of any form, can almost be said to be a deformity confined exclusively to females. The relative number is so great as to render us unable to make any approximation to the proportion, and when it does occur in males, it is attributable either to some mechanical cause, or to some defect in the nervous system. Therefore we may say that lateral curvature is a disease peculiar to females. We have said the period of its development is at puberty. At this time the bony structure increases in length much more rapidly than at any other; the figure often shoots up several inches in a few months, the muscles and soft tissues do not appear to keep pace with them; this is particularly so with those who are subsequently affected with lateral curvature.

There is a disproportion of development between the osseous and the soft tissues.

The muscles are weak, and are soon fatigued; the individual has a feeling of lassitude and indisposition to exercise that requires an unusual and special effort of the will to overcome; this unusual effort exhausts them in the same ratio that an equally unusual effort would the most robust and athletic. The face, as has before been said, is pale, has an anxious, somewhat haggard expression. This appearance of the face often precedes the curve, therefore is not dependent upon it. This form of curvature occurs in families, where other members are predisposed to phthisis, and of those affected with curvature, the *vast* majority die with consumption before the age of thirty. Again, it is not uncommon for members of the same family to be affected with dilatation of the heart. The lassitude before mentioned is a marked characteristic in persons predisposed to lateral curvature. This deformity often occurs in several members of the same family, and it is not unfrequent that the mother and one or more of the daughters are afflicted. We have known the mother and four daughters—all the females in the family—thus affected. This hereditary tendency would indicate that the disease was *not* owing to some accidental cause, like confinement to a badly-constructed seat in a school-room, to leaning upon one elbow, to the contracting of a bad habit of lounging, to tight-lacing, &c. These bad habits of position are the *consequence* of the lassitude experienced, and not the *cause.* At first the individual possesses the power, by a voluntary effort, to sit erect and bring the spinal column into its normal position, but they *cannot* maintain it. The effort exhausts rapidly the nerve power, and the muscles are absolutely obliged to give way and throw the strain upon the ligaments, if the body is not artificially supported. Hence the utter futility of constantly cautioning one, thus predisposed to lateral curvature, to sit or stand erect; it is as impossible for them, as it would be for the cautioners to hold their arms at right angles with the body by the hour. Can these conditions and results be philosophically accounted for by any or all of the accidental causes that have been given by writers? Do they not indicate a change effected at the period of puberty that is decidedly constitutional? The testimony drawn from the condition of the bones, cartilages, and ligaments, after a curvature has existed for years, as proving the cause of the deformity, is perfectly fallacious, for the reason that the same result will take place in any other joint, when retained for the same length of time in the same abnormal position. The condition is the *result* of the curvature and *not the cause.* The bones and cartilages will be absorbed by *unremitting pressure*, the ligaments will be *actually lengthened* by *unremitting tension*, those that are *relaxed uninterruptedly* will *not* be renewed any longer than the distance between their points of origin and insertion. *These laws of the animal economy, therefore, can be relied upon; they ought to govern us in considering the condition of joints or parts that have long been in an abnormal position.*

We have endeavored to point out the conditions and some of the constitutional tendencies of those predisposed to or afflicted with lateral curvature of the spine. We might term this the constitutional form of curvature, in distinction from those cases that arise from some mechanical cause.

To say definitely what the disease is would be more than our present knowledge would warrant. That dilatation of the heart occurs in the same family, and palpitation, together with the lassitude and indisposition to exercise in almost all cases of this disease, would point to some defect in the muscular system. Again, that the large majority die with phthisis, and other members of the same family, who have not a curvature, not unfrequently are the subjects of this disease, together with the fact that dilatation of the heart occurs in others, would point to struma as being the predisposing cause. There is another cause that may in some cases serve to develop this affection of the muscles—one which it is most difficult to ascertain the truth as to its existence in any individual case, viz., self-abuse, or masturbation. This indulgence more frequently affects the muscles of the lower extremities. We have seen it in the lower animals, from excessive venery when young, deforming the lower limbs until they twisted about in the act of walking. We have also seen the same in young children, from self-abuse.

This particular form of lateral curvature is distinct from all those cases that may be dependent upon some accidental or mechanical cause, or some disturbance of the nervous system.

We have quoted the views of Dr. J. B. Brown, of Boston, Mass. Plausible as they appear, they not only do not account for all the phenomena, but, were they true, lateral curvature should be nearly as frequent among boys as with girls—the former are as much exposed to the influences he mentions; yet it may be said that the constitutional form of this disease seldom, if ever, affects them, and a case of lateral curvature in the male from any cause is very rare in comparison. The causes he gives, therefore, cannot be the primary ones; where there is a predisposition, they might act as exciting ones. Again, if these causes were primary, they should give rise to curvature of the left nearly as frequently as to the right. We do not recall a case where this constitutional form affected the left side. It would be an anomaly if not one out of the large number afflicted with curvature should not (if Dr. Brown's views are true), by their position while in the school-room, or some bad habit of posture, develop a curvature to the left. We must therefore discard Dr. Brown's theory as to *the* causes of lateral curvature of the spine. Neither can we agree with the eminent French physician, Dr. Portal, that tight-lacing is a cause. Stays are usually applied as the young female is developing into womanhood, and, therefore, would very naturally get the credit of originating the disease. The argument would be, that there was no curvature when the stays were applied, and that the curve commenced soon after, and while they were worn. All this may be true, and yet be merely a coincidence, the same period of life, viz., puberty, being the time both for putting on stays and for the development of curvature. Besides, there are hundreds of cases of curvature where the person never had worn stays at any time.

There is one indication of a curvature not mentioned by authors—a person that has a decided curve of the spine, with gyration, will apparently take a long step with one foot and a shorter one with the other. This arises from the fact that the pelvis does not stand parallel with the chest, consequently one limb stands a little in advance of the other, and retains this difference in the act of walking, so that, if the attention is directed to the feet of a lady, one foot will appear to step farther than the other. This can never be remedied by the dress-maker. We often see in the street the perfection of art in the figure, where this peculiarity in walking betrays the existence of a curvature.

WHEN APPARATUS IS NECESSARY.

Artificial support is required when the curve has advanced to that stage when the muscles are unable to overcome the deformity, when the patient cannot by a voluntary effort bring the spine into its normal position. This may be owing to want of muscular power, to shortening of the ligaments, or to the deformity being so great as to bring the action of the muscles across the curve, in which position their contraction would increase rather than diminish the curve. To illustrate the effect of this position of the muscles, we will suppose the patella, by an incurvation of the limb, to be thrown outside the condyle. If the extensor muscles contract, they draw the tibia outward, and, at the same time, flex instead of extending it.

The proper direction of the muscles must first be secured, or at least, so far that their action shall not be a hinderance to restoration. This is a general rule. There are instances when the increased power of one or more sets of muscles might be made to restore the normal position of others, the latter being kept at rest during the exercise. Apparatus for lateral curvature should compel the use of the muscles that operate to balance or sustain the body erect, the same as if no apparatus were worn; it should act exclusively upon the curves. Before the patient loses the power of overcoming the curve, to a great extent at least, by voluntary efforts, special exercises to increase the power of certain muscles is all that is necessary. With our views of the condition of the system under which lateral curvature is developed, it would naturally follow that care should be taken not to tax the muscles of the spine to any great degree of fatigue in sustaining the body erect. Whenever the patient experiences fatigue in sustaining the upright position, the recumbent should be assumed. The latter need not be one of idleness, for it is the best position to exercise those muscles of the spine that serve in their contractions to restore its normal line. In this prone position, they can spend their whole power in overcoming the curve, as they have not the weight of the body to sustain.

TREATMENT.

We have said that, in those cases where the spine cannot be brought by the patient into its normal position, or readily restored by the hands of the surgeon, apparatus should be applied—apparatus that will affect the spine similarly to the hands of the surgeon, when he attempts a restoration. The apparatus should not confine the muscles, but aid them in overcoming the deformity. It must not impede or interfere with the process of educating the muscles, but should aid them in their efforts to overcome the curvature. There is another physiological consideration in the use of apparatus based on these principles—it serves to bring the form up until the muscles and ligaments that are shortened become tense, and there hold it; the force being elastic, if the parts yield, the instrument follows up, retaining the muscles and ligaments at the same degree of tension. We have before stated that soft tissues, when drawn tight and thus retained, elongate by the deposition of new material. Position may in many cases take the place of apparatus, gravity being the force; but this mode is always liable to be interfered with. If the position is changed, the treatment is interrupted, whereas the apparatus goes with the patient. Positions should always be used as an auxiliary to the apparatus. Position, as has been remarked, can remove the weight of the body, and the necessary contraction of the muscles in sustaining the body erect. Apparatus that acts upon the body, as has been stated, will prevent a curvature from increasing, and overcome the tendency so as to enable the patient to dispense with its aid, but it is seldom the spine can be restored to its normal position and a cure effected without extraneous aid.

To describe the particular manner in which each muscle or set of muscles is to be educated, so as to overcome and cure lateral curvature of the spine, would require a volume by itself, and then would not be of much service to the surgeon. It would occupy much the same place that an enumeration of the articles of the materia medica would to the physican as an aid in curing disease. The surgeon must examine each case by itself, and adapt his exercises to overcome the deformity by directing the voluntary efforts of the patient. The voluntary contraction of those muscles that most effectually aid in restoring the spine are the means most to be relied upon to effect a permanent cure. The surgeon, who cannot apply mechanical principles to the treatment of lateral curvature of the spine would do better to save his time and reputation by not attempting it. To aid the surgeon to commence his treatment, we will give the following directions: place the patient upon a level surface, not very yielding, the face downward, the back exposed the whole length and breadth. In this position gravity does not interfere with the action of the muscles, and their whole force can act directly upon the spine, without any interference in balancing the body, as when in an upright position. When thus placed, all the muscles of the back are under the eye of the surgeon during their contraction. He can now direct the patient to throw the body into any posture he may think best adapted to overcome the deformity. He can change his phraseology or directions until he succeeds in inducing the contraction of *some* muscles that he sees affect the curvature favorably. When he has succeeded in this, he may find it as difficult to get the contraction renewed again in the same way. He must follow it up, however, until the patient will perform *some one effort* continuously. This latter point is very important. If he is not watchful and does not continue his oversight of the operation, until it has been done repeatedly without once missing, he will find upon his next examination, that the patient has changed, unconsciously, to some effort that is positively injurious. Never attempt but one new motion at an exercise, as it will only confuse the patient. After they have learned one exercise well and thoroughly, another may be taken up, omitting the first until the second is well learned; then the two may be alternated. The combination may be increased as the effect is favorable and the patient able to remember, until all the muscles that tend to overcome the deformity have been under training, and their power so much increased that the spine will remain in its normal position. It is expected that the patient will pursue these exercises through the day, as a system of labor, and not as a mere pastime, as they often will. If fatigued by the exercise of any particular set of muscles, they can rest, or change to that of some other set not fatigued. After the examination by the surgeon, the patient can change to her back and practise her lesson. Let the surgeon insist upon its being a laborious work. One week of *constant* exercise is of more value in restoring the curvature than the same labor spread over four weeks. The idea that such exercises should not be carried to the point of fatigue, or that they should be performed by some one else, is absurd, and well designed to secure the services of some "manipulator." It is not by the labors of another that the athlete acquires his large and powerful muscles. It would be as reasonable to expect to become a vigorous thinker by employing some one to do our thinking as to expect strong muscles by employing another to will and contract their muscles while performing our movements.

We will mention another position and combination of muscular efforts, where gravity is to be overcome. If the curve is to the right side in the dorsal region, and to the left in the lumbar, place the patient upon the *right side*, the lower limb straight, a bar or strap hanging over the left shoulder, and just within reach of the left hand. The patient grasps the bar or strap with the left hand, and raises the upper portion of the trunk sufficiently far that the whole weight may rest upon the muscles going from the dorsal vertebra, and upon the pectoral muscles. By turning the body rather toward the face, the muscles from the spine to the scapula will receive the greatest strain. The head should be left as at first, while at the same time the lumbar muscles are contracted, raising the pelvis from the couch. This last act draws the pelvis to a right angle with the lumbar vertebra, whereas, before, it was an obtuse angle on the right side. The muscular fibres that pass in a straight line from the dorsal vertebra to the scapula receive most of the weight, and, as they have their origin on the concave side of the curve, they tend to bring the centre up, while the head above and the other portion of the trunk below remaining the same, the deformity is overcome. This exercise acts mechanically to straighten the curves. It does not dispense with the exercise of the muscles that balance the body. When pursuing this exercise, the body can be twisted upon itself to overcome any gyration that may exist. This is simply one of the many exercises that can be adopted. The ingenuity of the surgeon will enable him to readily devise positions, etc., for exercising any of the muscles he may desire.

CONSTITUTIONAL TREATMENT.

From what has been said of the condition of a person afflicted with lateral curvature of the spine, it is evident that a sustaining, invigorating course of medical treatment is indicated. Of the remedies most useful, tonics that affect most directly the nutritive system are the most desirable. While doing this, we should select those that also increase the nerve power of the muscular system. Among the articles that possess both powers, the several species of strychnos stand most prominent. The profession are most familiar with the strychnos nux vom. This perhaps is the best of all the species. We would most decidedly object to the use of the alkaloid strychnia as the best preparation of the nux vomica. This preparation possesses but a very small part of the tonic power to the nutritive system of some of the other preparations; again, its great power over the muscular system, in producing tetanic spasms, renders it a dangerous article to administer to children. We have used the alcoholic tincture of the rasped seeds of the strychnos nux vomica more than any other preparation. This tincture is one of the best, if not the best single article for increasing the appetite and the ability to digest and assimilate food, within our knowledge. We use it in much larger doses, however, than the books prescribe. We have given it in teaspoonful doses to adult males, and forty or fifty drops to females; to children in the same proportion. We frequently combine it with the comp. tinct. cinchona.

A favorite prescription is the ext. nux vom. and nit.

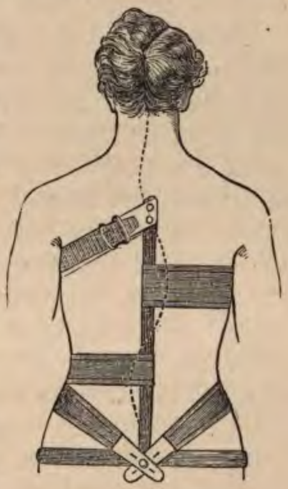
argentii: three-quarters or seven-eighths of a grain of the former to one-quarter gr. of the latter, in the form of pill, for an adult. This, when the tongue is soft and white, the tissues soft and flabby, or where the system requires arousing from a torpid condition of all its functions, is most valuable. This pill, in all diseases of the joints, particularly where there is a profuse discharge, is of more value than any other single combination. It increases the appetite, checks the discharge, and brings the system up to that standard of vitality where healthy granulation will ensue. The rhus, particularly the rhus venanata, popularly known as swamp sumach, poison-oak, dogwood of New England, is a valuable adjuvant. Their effect is somewhat like that of the nit. argentii; yet it will produce involuntary contraction of paralyzed muscles. If there is any condition of the system requiring the effect of any other medicines, such as alteratives, etc., they should be given as in other cases. Avoid all those medicines that reduce the vital energies. Put the system in the best possible condition to receive and assimilate the greatest amount of food, and we have that state that will best enable it to counteract and resist disease.

Add to this a generous diet, exhilarating exercises in the open air, such as horseback riding, etc. If the special exercises are practised in the prone position, these exercises will be taken with great enjoyment. One hour a day will be sufficient for out-door exercises. In most young ladies predisposed to or affected with lateral curvature, the chest is not well developed, the lungs are confined, and the function of respiration is imperfectly performed. So long as this condition remains, it will be useless to increase the appetite, with the expectation of an increase of assimilation. It is a law that digestion and assimilation are in proportion to the respiration, other things being equal; therefore, some exercise for the purpose of enlarging the chest should be adopted. This can be done by suspending the weight of the body by the arms, from a bar or rope and rings. This should be followed, like the other exercises, very faithfully.

DESCRIPTION OF APPARATUS.

The base of the instrument is a steel band, from five-eighths to three-quarters of an inch wide, the thickness of the steel from No. 15 to 19, according to the size of the instrument and the strength required. This has a cushioned covering. The length is sufficient to encircle the pelvis just below the superior spinous process of the ilia. There are several holes in each end, for the purpose of altering the length, and for securing the upright back steel by a button-headed screw and nut. In the centre of the pelvic band, in front, is a hole through which the front upright steel is fastened by the same kind of screw. To these buttons, the band or bands over the crest of the ilia are attached; these sustain all the pressure downward that may arise from lifting of the left shoulder, by the band under that arm.

The upright steels are of various widths and thicknesses, according to the size of the instrument. The largest for an adult are about one inch and one-eighth wide, and thicker than the pelvic band. These are covered with leather, and are provided with two holes at each end, one inch apart, one set for altering the length, the other for securing the upper band that passes under the left arm. This band under the left arm is of heavy rubber webbing, two inches wide, with buckles on each end, to buckle upon the non-elastic webbing riveted to the tops of the steels This upper band under the arm rests upon the ribs that are attached to the spine at the upper portion of the dorsal curve, while the bands upon the opposite side pass from one steel to the other over the ribs that touch the spine at the centre of the same curve. If there is another curve in the lumbar region, another band should go from one steel to the other over its centre. These bands may all be of rubber webbing; but it is not necessary that any more than the upper one should be so, as the elasticity of this acts upon that of the opposite side.



It will be observed that where a band passes around one side of the chest, the opposite side is free, so that the chest is free to move over in that direction, neither is it contracted as it would be if the bands encircled it. The pressure upon the ribs in this way is similar mechanically to pressure upon the end of a lever, while it is left to move to and fro. The pressure, under such circumstances, does not impede to any great extent the lateral motion of the lever; so, with this band over the ribs, they move up and down, during respiration, without much increase of effort. As these upright steels are not stayed laterally, they will fall over when the bands upon the sides of the the body are removed. This is mentioned to show that the instrument does nothing toward holding the body laterally; the patient uses the muscles to balance the body the same as if without the instrument, while the bands, acting as they do only upon the curves, tend to bring the spine into its normal position. The instrument, as has been stated, serves to bring the contracted muscles and shortened ligaments tense, thereby putting them in a condition to be lengthened by the deposition of new material. This is of great importance in curves of long standing, and is the only way, in fact, by which they can be remedied. If this instrument is applied to a person without a curvature, it will force the spine into a fac-simile of a curve from disease, but in the opposite direction. The instrument should be worn during the night, the recumbent posture being the best, as the instrument then does not support any of the weight of the body, or have to resist any contractile force of any of the muscles. This posture, therefore, is one most advantageous during the day.

We notice in a very able paper entitled "A Report on Orthopedic Surgery, for the annual meeting of the Illinois State Medical Society, held in Bloomington, May 2d, 1865, by David Prince, M. D., of Jacksonville, Illinois," a description of our apparatus for the treatment of lateral curvature of the spine, in which it is represented as a "modification of Tavernier's Belt." We are surprised that the doctor should have so mistaken our apparatus. It probably was owing to the fact that he had only a cut of it as applied to a patient, and this without any description. The cut gives a view of the back of a patient, and the doctor appears not to have understood that there was an upright steel on the front of the body, to which the bands were attached in a similar manner to the one upon the back. The front part of the apparatus is similar to that upon the back. The upright steels will not sustain themselves in an upright position, but turn upon a screw at the bottom, where they are confined to the pelvic steel band. The upright steels fall to either side, when not held up by the bands around the body. It is this peculiarity of our apparatus to which we allude, when we say that the patient should be compelled to use the muscles to balance the body the same as if no apparatus were worn. This necessity of using the muscles of the trunk prevents atrophy or any irregular development of one or more muscles by an irregular exercise of them, in consequence of some being prevented from contracting by reason of compression. In the belt referred to by Dr. Prince, there is but one upright steel, and that upon the back, where it is secured at its lower end immovably to the pelvic band. To this upright steel, bands are attached that pass spirally around the body, and are secured to the pelvic band in front, that wind to the right partially around the body, and are secured to the pelvic steel in front. On the left side is the crutch. This arrangement effectually prevents the natural use of the muscles to balance the body. Our apparatus not only allows, but *compels* the patient to use the muscles when wearing it, the same as when without it. We say our apparatus, as it is the only one we have seen that allows the muscles to act without restraint, and the patient to use them precisely and under the same circumstances as they would without the apparatus, with the exception that, in so far as the instrument serves to overcome the curvature, it serves to bring the action of the muscles into a more normal state, as to direction. The doctor gives a description of an apparatus of his devising, which he says is more simple, inasmuch as he says it "can be executed by any ordinary mechanic, and by any physician." He describes it as consisting of *six pieces of steel*, "all the parts are properly padded and armed with straps and buckles." The instrument we use has *but three flat steels* instead of six, less padding, and a less number of buckles and straps. We may be mistaken, but we *cannot* see how an apparatus composed of *six pieces of steel*, and all the other parts more numerous and more complicated, can be more "simple" or more easily made by an ordinary mechanic than an instrument with *only three pieces of flat steel*, and all the other parts equally simple. Indeed, we do not see how an instrument *can* be more simple than ours, and we prided ourselves upon this as one of its prominent features. We have said this much because the doctor recommends his as being more simple, and *not* because it is more efficient.

SYNOVITIS.

INFLAMMATION of a synovial membrane may occur as the direct result of a local injury to the joint, such as a blow causing a wound or contusion; or it may be excited by the presence of inter-articular bodies, a sprain, or exposure to cold; or it may result as the local expression of a constitutional cause, such as syphilis, gout, gonorrhœa, rheumatism, scrofula, eruptive fevers, pyemia, or excessive use of mercury.

It is equally liable to occur in both sexes; and, as regards age, is more frequent in early adult life, as the common form of diseased joint in the sub-acute variety. It may affect any of the articulations supplied with synovial membrane; but in the great majority of cases is found in the knee-joint, to the extent of seventy-five per cent. as compared with its appearance in other joints, probably on account of the greater exposure of the knee to mechanical violence, and the greater extent of synovial surface.

Many cases undoubtedly occur as the result of the conjoined influence of local injury, perhaps too slight at the time to attract much notice, but yet sufficient to give a diverting tendency to the latent constitutional taint—the peculiar cachexia modifying the character of each case.

The disease may also result from extension of inflammatory affections of the soft tissues without, or of the bones within; the most disastrous form being that resulting from the discharge of pus into the articulation.

The following anatomical outline may conduce to a better understanding of our subject, and a more thorough appreciation of the *modus operandi* of our treatment in special joint diseases.

The articulations are classified by anatomists into *synarthrosis*, or *immovable ; amphiarthrosis*, or *mixed ;* and *diarthrosis*, or *movable ;* and each of these divisions is still further subdivided.

The components of a joint are bone, cartilage, fibrocartilage, ligament, and synovial membrane.

If a joint is *immovable*, as between the cranial bones, their adjacent margins are applied with simply a thin layer of fibrous membrane interposed ; but in the movable joints, the bones forming the articulations are covered by an elastic substance, called *cartilage*, held together by strong bands or capsules of fibrous tissue, called *ligament*, and lined throughout by a *synovial membrane* which secretes a fluid by which the joint is lubricated.

As pertains to the anatomy elsewhere, the bones form the fundamental base to which the soft tissues of the joints are attached, especially the articular cartilages, which are firm, opaque, bluish-white substances, formed upon the articular surfaces of the bones, as anti-friction coverings. The cartilage covering the ends of bones, forming different kinds of articulations, is correspondingly varied in its disposition. That covering the rounded ends of the femur and humerus is thick at the centre, and becomes gradually thinner toward the circumference ; while that lining the corresponding cavities of these articulations is arranged in an opposite manner. The cartilage on the articular surfaces of the short bones, as the carpus and tarsus, is disposed in a layer of uniform thickness throughout. Articular cartilage in the adult does not contain blood-vessels, its nutrition being principally derived from the vessels of the synovial membrane which skirt the circumference of the cartilage; nor have lymphatic vessels or nerves, as yet, been traced in its substance.*

Fibro-cartilage consists of a mixture of white fibrous and cartilaginous tissues, in various proportions; the white fibrous giving strength and toughness, and the cartilaginous constituent, elasticity.

Fibro-cartilages are arranged into four groups: the inter-articular, inter-osseous, circumferential, and stratiform.

The *inter-articular fibro-cartilages* are flattened fibro-cartilaginous plates, of a round, oval, or sickle-like form, interposed between the articular surfaces of certain joints; are free on both surfaces, thinner toward their centre than at their circumference, and held in position by their extremities being connected to the surrounding ligaments. The synovial membrane of the joint is prolonged over them a short distance from their attached margin. They are found in the *temporo-maxillary*, *sterno-clavicular*, *acromio-clavicular*, *wrist* and *knee-joints.*

The *inter-osseous fibro-cartilages* are interposed between the bony surfaces of those joints which admit only of slight mobility, as between the bodies of the vertebræ and the symphisis pubis; and exist in the form of disks intimately adherent to the opposed surfaces, being composed of concentric rings of fibrous tissue, with cartilaginous laminæ interposed; the former tissue predominating toward the circumference, the latter, toward the centre.

The *circumferential fibro-cartilages* consist of a rim of fibro-cartilage which surrounds the margins of some of the articular cavities, as the cotyloid cavity of the hip, and the glenoid cavity of the shoulder; and serve to deepen the articular surface, and protect the ends of the bone.

The *stratiform fibro-cartilages* are those which form a thin layer in the osseous grooves, through which the tendons of certain muscles glide.

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* The more recent view, however, is, that it derives its nourishment from the bone below.

Ligaments are found in nearly all tne movable articulations, and consist of bands of various forms, serving to connect together the articular extremities of bones, com. posed mainly of bundles of white, fibrous tissue, closely interlaced, and presenting a white, shining, silvery aspect; are pliant and flexible, so as to allow of the most perfect freedom of movement, but strong and tough. There are some ligaments which consist of yellow, elastic tissue, as the ligamenta subflava, which connect together the adjacent arches of the vertebræ

Synovial membrane is a thin, delicate membrane which invests, more or less perfectly, the articular extremities of the bones, and is then reflected on the inner surface of the various ligaments which connect the articulating surfaces. It resembles the serous membrane in being a shut sac, but differs in the nature of its secretion, which is thick, viscid, and glairy, like the white of an egg—transparent, yellowish-white, or slightly reddish, and having an alkaline reaction and slightly saline taste.

The synovial membranes found in the body admit of subdivision into three kinds: articular, bursal, and vaginal.

The *articular synovial membranes* are found in all the freely movable (diarthrodial) joints. In the fœtus, this membrane may be traced over the entire surfaces of the cartilages; but in the adult it is wanting, except at their circumference, upon which it encroaches for a short distance; it then invests the inner surface of the capsular or other ligaments inclosing the joint, and is reflected over the surface of any tendons passing through its cavity, as the tendon of the popliteus in the knee, and the tendon of the biceps in the shoulder.

In some joints the synovial membrane is thrown into numerous folds, which project forward into the cavity. These folds consist of a reduplication of the synovial membrane, some of them containing fat, and, more rarely, isolated cartilage-cells; the free borders of the longer processes being subdivided into vascular fringe-like processes, the vessels of which have a convoluted arrangement. They are especially distinct in the knee, where they are known as the mucous and alar ligaments, and were described by Clopton Havers as *mucilaginous glands*, and as the source of the synovial secretion, a view since revived by Mr. Rainey, who finds them in the bursal and vaginal, as well as in the articular membranes.

The *bursal synovial membranes* (bursæ mucosæ) are found interposed between surfaces which move upon each other, producing friction, as in the gliding of a tendon, or of the integument over projecting bony surfaces. They are small, shut sacs, connected by areolar tissue with the adjacent parts, and secreting a fluid in their interior analogous to synovia. The bursæ admit of a subdivision into two kinds, subcutaneous and deep-seated.

The *subcutaneous* are found in various situations, as between the integument and front of the patella, over the olecranon, the malleoli, and other prominent parts.

The *deep-seated* are more numerous, and usually found interposed between muscles or their tendons, as they play over projecting bony surfaces, as between the glutæi muscles and surface of the great trochanter. Where one of these exists in the neighborhood of a joint, it usually communicates with the cavity of the synovial membrane, as is generally the case with the bursa between the tendon of the psoas and iliacus, and the capsular ligament of the hip, or the one interposed between the under surface of the subscapularis and the neck of the scapula.

The *vaginal synovial membranes* (synovial sheaths) serve to facilitate the gliding of the tendons in the osseo-fibrous canals through which they pass. The membrane is here arranged in the form of a sheath, one layer of which adheres to the wall of the canal, and the other is reflected upon the outer surface of the contained tendon, the space between the two free surfaces of the membrane being partially filled with synovia.

These sheaths are chiefly found surrounding the tendons of the flexor and extensor muscles of the fingers and toes, as they pass through the osseo-fibrous canals in the hand or foot.

The articulations furnished with synovial membrane are as follows, arranged alphabetically:

Ankle-joint—is a ginglymoid or hinge-joint. The bones entering into its formation are the lower extremity of the tibia and its malleolus, and the malleolus of the fibula, above; which, united, form an arch in which is received the upper convex surface of the astragalus and its two lateral facets.

The synovial membrane invests the cartilaginous surfaces of the tibia and fibula, and sends a duplicature upward between their lower extremities; it is then reflected on the inner surface of the ligaments surrounding the joint, and covers the upper surface of the astragalus and its two lateral facets below.

Astragalo-scaphoid.—The articulation between the astragalus and scaphoid is an enarthrodial joint; the rounded head of the astragalus being received into the concavity formed by the posterior surface of the scaphoid, the anterior articulating surface of the calcaneum, and the upper surface of the calcaneo-scaphoid ligament, which fills up the triangular interval between these bones. The synovial membrane which lines this joint is continued forward from the anterior calcaneo-astragaloid articulation.

Atlo-axoid.—The articulation of the anterior arch of the atlas with the odontoid process of the axis forms a lateral ginglymoid joint, while that between the articulating process of the two bones forms a double arthrodia.

There are *four* synovial membranes in this articulation: one lining the inner surface of each of the two capsular ligaments; one between the anterior surface of the odontoid process and anterior arch of the atlas; and one between the posterior surface of the odontoid process and the transverse ligament.

This synovial membrane often communicates with those between the condyles of the occipital bone, and the articular surfaces of the atlas.

Calcaneo-astragaloid.—The articulation between the astragalus and os calcis is an arthrodial joint, connected together by three ligaments and having two synovial membranes; one for the posterior calcaneo-astragaloid articulation, a second for the anterior calcaneo-astragaloid joint. The latter synovial membrane is continued forward between the contiguous surfaces of the astragalus and scaphoid bones.

Carpal.—There are two synovial membranes found in the articulation of the carpal bones with each other. The first of these, the more extensive, lines the under surface of the scaphoid, semilunar, and cuneiform bones, sending upward two prolongations between their contiguous surfaces; it is then reflected over the bones of the second row and sends down three prolongations between them, which line their contiguous surfaces, and invest the carpal extremities of the four outer metacarpal bones. The second is the synovial membrane between the pisiform and cuneiform bones.

Chondro-sternal.—The articulations of the cartilages of the true ribs with the sternum are arthrodial joints. The articulation of the cartilage of the first rib is not supplied with a synovial membrane.

The articulation of the cartilage of the second rib is provided with two synovial membranes. That of the third rib has also two synovial membranes; while that of the fourth, fifth, sixth, and seventh, has each a single synovial membrane. After middle life, the articular surfaces lose their polish, become roughened, and the synovial membranes appear to be wanting. The cartilages of the sixth, seventh, and eighth ribs articulate, by their lower borders, with the corresponding margin of the adjoining cartilages, and each articulation has a perfect synovial membrane, inclosed in a thin capsular ligament.

Costo-transverse.—The articular portion of the tubercle of the rib and adjacent transverse process form an arthrodial joint, provided with a thin capsular ligament, attached to the circumference of the articulating surfaces, and inclosing a small synovial membrane.

Costo-vertebral.—The articulation between the heads of the ribs and the bodies of the vertebræ form a series of angular ginglymoid joints. In the first, eleventh, and twelfth ribs, the inter-articular ligament does not exist, but in the others, it divides the joint into two cavities, which have no communication with one another, and are each lined by a separate synovial membrane. In those three mentioned in which the inter-articular ligament does not exist, there is but one synovial membrane each.

Elbow.—The elbow is a ginglymoid joint. The synovial membrane is very extensive. It covers the articular surface of the humerus, and lines the coronoid and olecranon depressions on that bone; from these points it is reflected over the anterior, posterior, and lateral ligaments; lines the greater sigmoid cavity, the concave depression on the head of the radius, and forms a pouch between the lesser sigmoid cavity, the internal surface of annular ligament, and the circumference of the radius.

Hip.—This is an enarthrodial articulation. The synovial membrane is very extensive. It invests the cartilaginous surface of the head of the femur, and all that portion of the neck which is contained within the joint; from this point it is reflected on the internal surface of the capsular ligament, covers both surfaces of the cotyloid ligament, and lines the cavity of the acetabulum, covers the mass of fat contained in the fossa at the bottom of this cavity, and is prolonged in the form of a tubular sheath around the ligamentum teres on to the head of the femur.

Intercostal.—The cartilages of the sixth, seventh, and eighth ribs articulate by their lower borders with the corresponding margin of the adjoining cartilages, and each articulation has a perfect synovial membrane, inclosed in a thin capsular ligament.

Knee.—The synovial membrane of the knee-joint is the largest and most extensive in the body. Commencing at the upper border of the patella, it forms a large cul-de-sac beneath the extensor tendon of the thigh; this is sometimes replaced by a synovial bursa interposed between this tendon and the femur, which in some subjects communicates with the synovial membrane of the knee-joint, by an orifice of variable size. On each side of the patella, the synovial membrane extends beneath the aponeuroses of the vasti muscles, and more especially beneath that of the vastus internus; it is said to cover the surface of the patella itself, and, beneath it, is separated from the anterior ligament by a considerable quantity of adipose tissue.

In this situation it sends off a triangular-shaped prolongation, containing a few ligamentous fibres, which extends from the anterior part of the joint below the patella to the front of the inter-condyloid notch. This fold has been termed the ligamentum mucosum.

The ligamenta alaria consist of two fringe-like folds, which extend from the sides of the ligamentum mucosum, upward and outward, to the sides of the patella.

The synovial membrane covers both surfaces of the semilunar fibro-cartilages, and on the back part of the external one forms a cul-de-sac between the groove on its surface and the tendon of the popliteus; it covers the articular surface of the tibia; surrounds the crucial ligaments, and inner surface of the ligaments which inclose the joint; lastly, it covers the entire surface of the condyles of the femur, and from them is continued on to the lower part of the front surface of the shaft.

The pouch of synovial membrane between the extensor tendons and front of the femur is supported, during the movements of the knee, by the subcruræus, which is inserted into it.

Metacarpal.—The synovial membrane supplied to the metacarpal articulations is a reflection of that between the two rows of carpal bones.

Occipito-atloid.—The synovial membranes of this articulation, between the occipital bone and atlas, communicate occasionally with that between the posterior surface of the odontoid process and transverse ligament.

Phalanges.—The arrangement of these articulations is similar to that of the other joints of the hand, and are supplied with synovial membrane.

Radio-ulnar, inferior.—The synovial membrane of this articulation has been called, from its extreme looseness, the membrana sacciformis; it covers the articular surface of the head of the ulna, and, where reflected from this bone on to the radius, forms a very loose cul-de-sac; from the radius it is continued over the upper surface of the fibro-cartilage. The quantity of synovia which it contains is usually considerable. When the fibro-cartilage is perforated, this synovial membrane is continuous with that which lines the wrist-joint.

Radio-ulnar, superior.—The bones entering into this articulation are the inner side of the circumference of the head of the radius, which is received into the lesser sigmoid cavity of the ulna. These surfaces are covered with cartilage, and invested with a duplicature of synovial membrane continuous with that which lines the elbow-joint.

Sacro-iliac.—The articulation of the sacrum and ilium is, at an early period of life, lined by a delicate synovial membrane.

Scapulo-clavicular.—This articulation is supplied with two synovial membranes where a complete inter-articular cartilage exists. More frequently there is only one synovial membrane.

Shoulder.—The synovial membrane lines the glenoid cavity and the fibro-cartilaginous rim surrounding it; it is then reflected over the internal surface of the capsular ligament, lines the lower part and sides of the neck of the humerus, and is continued over the cartilage covering the head of this bone.

The long tendon of the biceps muscle which passes through the joint is inclosed in a tubular sheath of synovial membrane, which is reflected upon it at the point where it perforates the capsule, and is continued around it as far as the summit of the glenoid cavity, where it is continuous with that portion of the membrane which covers its surface. The tendon of the biceps is thus enabled to traverse the articulation, but is not contained in the interior of the synovial cavity.

The synovial membrane communicates with a large bursal sac, beneath the tendon of the subscapularis, by an opening at the inner side of the capsular ligament; it also occasionally communicates with another bursal sac, beneath the tendon of the infra-spinatus, through an orifice at its upper part.

A third bursal sac, which does not communicate with the joint, is placed between the under surface of the deltoid and the outer surface of the capsule.

Sterno-clavicular.—Two synovial membranes are found in this articulation. One is reflected over the sternal end of the clavicle, the adjacent surface of fibro-cartilage, and cartilage of the first rib. The other is placed between the articular surface of the sternum and adjacent surface of the fibro-cartilage, and is more loose than the former. They seldom contain much synovia.

Tarsus.—The synovial membranes found in the articulations of the tarsus are four in number: one for the posterior calcaneo-astragaloid articulation; a second for the anterior calcaneo-astragaloid and astragalo-scaphoid articulations; a third for the calcaneo-cuboid articulation; and a fourth for the articulations between the scaphoid and the three cuneiform, the three cuneiform with each other, the external cuneiform with the cuboid, and the middle and external cuneiform with the bases of the second and third metatarsal bones. The prolongation which lines the metatarsal bones passes forward between the external and middle cuneiform bones.

A small synovial membrane is sometimes found between the contiguous surfaces of the scaphoid and cuboid bones.

Tarso-metatarsal.—The synovial membranes of these articulations are three in number: one for the metatarsal bone of the great toe, with the internal cuneiform; one for the second and third metatarsal bones, with the middle and external cuneiform—this is continuous with the great tarsal synovial membrane; and one for the fourth and fifth metatarsal bones with the cuboid.

Temporo-maxillary.—The synovial membranes of this articulation, two in number, are placed, one above and the other below the fibro-cartilage. The upper one, the larger and looser of the two, after lining the cartilage covering the glenoid cavity and eminentia articularis, is continued over the upper surface of the fibro-cartilage. The lower one is interposed between the under surface of the fibro-cartilage and the condyle of the jaw, being prolonged downward a little further behind than in front.

Thumb.—The articulation of the first metacarpal bone with the trapezium is furnished with a separate synovial membrane.

Tibio-fibular, inferior.—The synovial membrane lining this articulation is derived from that of the ankle-joint.

Tibio-fibular, superior.—This articulation is supplied with a distinct synovial membrane. Occasionally, the synovial membrane of the knee-joint is continuous with it at its upper and back part.

Wrist.—The synovial membrane lines the lower end of the radius and under surface of the triangular inter-articular fibro-cartilage above, and, being reflected on the inner surface of the ligaments, covers the convex surface of the scaphoid, semilunar, and cuneiform bones below.

The synovial membranes in the various movements of joints would be liable to be caught and contused between the articular surfaces, were they not protected by the mode in which the muscles surround them, and also by their attachments to the capsular ligaments, or to the sub-synovial tissue; which attachments not only exist in all the larger joints, but also in all the smaller joints possessing considerable freedom of motion. The ankle is provided with a special muscle, the plantaris, to draw the membrane from the grip of violent extension. Each synovial membrane of the digital joints, both of the fingers and toes, is in connection with the extensor and interossei tendons, so that ample care is taken, even in these small articulations, to prevent injury by being caught and pinched.

In cases of primary disease of joints, the synovial membranes and the bones are most liable to be affected, from either of which it may spread to the other, and to all other parts of the joint, and therefore neither synovitis nor osteitis is absolutely distinct throughout all its stages, as the one disease will be more or less mingled with the other.

SYMPTOMS.

The symptoms of synovitis are those which pertain to inflammation in general—heat, pain, redness, and swelling. When caused by a blow, but slight pain or inconvenience may be the immediate result of the injury; the patient may walk about or move the joint without much pain, but in a short time acute symptoms will make their appearance.

Severe pain locally will be the first felt, with more or less inability or disinclination to use the joint; any attempts to move or allow the part to be examined will considerably aggravate the symptoms, and the joint will, as a rule, be found in a partially flexed position. The position of the joints or limbs, respectively, is one of the most important features peculiar to this disease.

Effusion rapidly takes place, distending the synovial sac, which can be recognized by its bulging out from between the bones.

As the disease becomes established, the suffering is frequently severe. Where the attack arises from exposure, the patient is generally awoke in the night by pain. The pain is sometimes described by the patient as being like an internal bruise; sometimes as though a hot iron were in the bone.

In other instances, a sensation of great distension is the principal complaint, the patient expressing it as though the joint were being forced asunder by mechanical violence. The pain in certain joints passes also to other parts of the limb, as for instance, synovitis of the elbow causes pain running down the arm to the little finger or to the back of the thumb and index.

When the disease is situated in the hip, it also causes pain in the knee.

Heat is a constant symptom, even when the disease is situated as far from the surface as in the hip; but the heat in different cases varies not only in degree, but to some extent in kind. Placing the hand over a knee affected with simple synovitis, we find it hot; if it be a traumatic case in the early stage, still hotter; but the heat will not appear very near the hand; the skin itself seems as though it were not so hot as some deeper lying structure, communicating its heat to the integument; but if we take a case of acute rheumatism, the heat may or may not be greater, but it comes immediately next the hand, being quite superficial.

In pyæmic and gonorrhœal cases, on the contrary, there is not generally so much heat as in simple synovitis.

The redness varies in a similar manner; in acute rheumatism, the joints attacked are very red; in simple synovitis, they are only slightly reddened. The pyæmic and gonorrhœal form do not cause any redness of the skin at all except over inflamed superficial veins and absorbents; and it would even appear that the joint were more pallid than its fellow.

The swelling is due, to a certain extent, to effusion into the surrounding tissues, as well as to increased secretion into the synovial sac. In an acute case of synovitis the constitutional symptoms will be proportionately severe; all those characteristic of fever, as hot and dry skin, flushed face, dry and furred tongue, quick and hard pulse will be present; and any attempt to examine the joint will be regarded by the patient with extreme anxiety. As the disease progresses, symptoms of suppuration make their appearance, as indicated by rigors and depressed powers, the joint will still be swollen, and perhaps to a greater extent, but the integuments and parts surrounding will have become involved; the skin will generally be inflamed and somewhat fixed, and in a short time actual pointing will be visible;

profuse and acute suppuration then follows, and in cases following an injury, and unchecked by treatment, the patient, already worn down by pain and the severity of the symptoms, rapidly sinks from hectic.

When it follows the discharge of an abscess into the joint or pyæmia, its progress is more rapid, and its results more fatal, the destruction of the articulation being a necessary consequence. When, however, acute synovitis arises spontaneously without any known cause, its progress is somewhat similar, although less rapid, and it is rare for acute suppuration of the joint to take place. When attacking strumous or cachectic patients, this result may occasionally ensue, but as a rule, this form—the idiopathic—is very amenable to treatment, and the destruction of the joint and death of the patient is exceptional.

In Rheumatic Synovitis the symptoms are usually well developed from the start. The attack often results from exposure to cold, or excess in eating or drinking, and the patient retires at night with some degree of soreness of the joints, accompanied by feeling of general malaise, and awakes with excessive pain, great tenderness on pressure of the affected parts, the integuments over which are liable to be discolored.

There is perhaps total inability to use the affected limbs, and the patient is feverish, with full, strong pulse, hot and dry skin, constipated bowels, and urine scanty and high colored, being loaded with urates.

The joints become gradually more deeply involved; the local symptoms increase in violence, an abundance of synovial fluid is secreted or effused, more or less distending the joint.

If the inflammation be not speedily abated, it will eventuate in suppuration, which event will be announced by the supervention of rigors and an increase in the already high constitutional excitement.

The knee, elbow, wrist, and ankle-joints are the ones most liable to be affected by rheumatic synovitis. The shoulder and hip-joints are very seldom involved.

When the disease affects the large joints at all severely, the articulations of the fingers, and particularly that of the great toe, rarely escape. Where the inflammation is developed in one joint, it is extremely prone to extend to others, and especially its fellow on the opposite extremity, and the knee-joint of either side, affected by rheumatism or gout, is almost invariably associated with an extension of the difficulty to its fellow opposite before the original attack is entirely subdued.

It is in chronic articular rheumatism that calculous concretions are liable to form in the joint.

Syphilitic Synovitis, as the local exhibition in the joints of coexistent syphilis in other structures, does not usually manifest itself until several years after the primary affection, and is classified among the tertiary forms.

It usually occurs in persons whose health has otherwise become impaired by intemperance and injudicious treatment for the primary or secondary variety of syphilis.

The knee and elbow are its most common seat, but it may exhibit itself in the smaller articulations.

The joint, in consequence of the effusion of synovial fluid, is swollen and fluctuating, motion is impeded, the parts are tender on pressure, and the pain becomes excessive, especially at night, and when the patient has become warm in bed, which latter circumstance, in conjunction with the history of the case, will conduce to a correct diagnosis.

Strumous Synovitis occurs most frequently in childhood, in patients of scrofulous diathesis, and commonly attacks the elbow, hip, or knee-joint. It is usually divided into three stages of pathological progress.

The tubercular disease of the joint may commence either in the areolar substance of the bone, in the articular cartilage, or may affect first the synovial membrane, or, as frequently happens, appear simultaneously in all these parts

It is usually slow in its progress, but almost certain to effect partial or complete destruction of the affected articulation, unless proper treatment intervene to prevent the progress of the disease beyond the reparative powers of nature.

In the latter stages, constitutional evidences of the joint affection may present themselves in the form of scrofulous lesions of the lungs, mesenteric glands, or spleen.

The development of the tuberculous diathesis in the joint may be traced to some exciting cause, as a fall, wound, or contusion; but, as the disease is so much more limited to childhood than later ages, the evidences, especially if the local injury has been slight, are not usually reliable.

Whatever tends to enfeeble the system and impoverish the blood may be enumerated among the exciting causes of this local manifestation of a constitutional disease, such as the various fevers—eruptive, typhoid, and intermittent. Hooping cough is a very common excitant of disease in the vertebral column. Diarrhœa and protracted hemorrhages, excessive use of mercury, inadequate nutrition, from unwholesome food, or imperfect digestion and assimilation, living in damp underground and ill-ventilated rooms, and the sudden suppression of the cutaneous perspiration, from exposure to cold, may all severally tend to the development of the cachexia in one predisposed.

The disease of the joint, during its progress, occasionally becomes complicated with other strumous diseases, as Potts's disease, strumous enlargement of the lymphatic ganglions of the neck, psoas abscess, ophthalmitis, and evidences of the internal struma.

When not immediately dependent upon some local cause, the symptoms at first are obscure and stealthy; and among the circumstances which attract attention earliest, are a sense of fatigue after exercise, and, if the disease is in the hip-joint (its most frequent seat), with slight pain in the knee, and a disposition to drag the limb, thus giving the gait an awkward and stiff appearance.

The temperament of patients subject to this form of disease is either the lymphatic or the lymphatic and sanguine conjoined. The lymphatic temperament is characterized by a pasty complexion, with pale and sometimes swollen or puffed countenance, soft and flabby state of the muscles, feeble circulation, inducing coldness of the feet, and dilated state of the pupil and sluggishness of intellect. The upper lip and abdomen are very apt to be tumid.

When the lymphatic is combined with the sanguine temperament, there is a well-developed state of the muscular system, with tendency to plumpness, rosy complexion, active circulation, and greater intellectual capacity.

There do not seem to be sufficient data to corroborate the opinion heretofore held that rheumatism is a common cause of this disease. On the contrary, strumous synovitis is very unusual in patients of rheumatic diathesis; and, when joint affections occur in rheumatic subjects, they differ materially from the tuberculous variety.

The awkward locomotion of the child having continued perhaps for weeks, the pain in the knee gradually increases, the limping becomes more distinct, and the limb is subject to spasmodic twitchings, which more or less disturb the sleep.

The pain is generally worse at night than during the day, and may vary in degree from a dull aching to a lancinating pain; and may also vary in its seat, sometimes seeming to be superficial, and at others, deep seated. It is liable to be aggravated by exercise of the part, atmospheric changes, and other disorders of the system supervening.

An examination of the knee-joint, to which the pain is referred when the strumous disease attacks the hip, shows that joint to be free from evidences of local disease, and tolerant of usual motion and handling. Sometimes the pain assumes a neuralgic or intermittent type, occurring perhaps in the evening, and after lasting a few hours, abating and entirely disappearing, to be followed by a recurrence the next evening and so on.

This remittent form is more likely to prevail in cases occurring in miasmatic regions.

The pain does not, for any definite time, confine itself to the knee; but extends to the thigh and leg when it arises from disease of the hip-joint—extending in the direction of some nervous trunk, as the sacro-sciatic, crural, saphenous, or obturator; and the pain may also localize itself over the tendo-Achillis, or over the instep, or may alternately shift from one locality to another. If the disease be in the knee, the mere erect posture, which keeps that joint low, will produce as much pain as walking about. The influence of position upon the pain is more marked and more unmistakable in the worst forms of cases. Sometimes the sensation of intense cold in the joint is the cause of much complaint, and is regarded of evil prognostication—those cases in which it has been most intense having been found most obstinate, and the most prone to degeneration.

The surface of the joint becomes by degrees whiter than normal; this is more marked the more strumous the case, and has endowed a large class of joint diseases with the name of *White-Swelling*. When the case is far advanced, this whiteness is very striking; for, as the swelling increases, the skin becomes stretched, polished, and of a dead-white hue, which appearance will aid in the diagnosis between strumous and malignant disease, in which latter the skin is usually of a brownish, coppery hue.

Up to this period there will probably be no very perceptible decline of the general health.

The second stage is characterized by an increase of the pain in the hip and knee, flattening of the buttock, apparent elongation of the limb, effacement of the gluteo-femoral crease, and twitching and wasting of the muscles of the part.

The pain in this stage is described as gnawing or boring in its character, and is particularly violent at night—often interrupting sleep for hours—and attended with the most distressing spasmodic twitches of the muscles of the limb, which add greatly to the local and general suffering.

The constant gnawing, boring, and sometimes erratic pains, and the chief shock resulting from the spasmodic twitchings of the muscles connected with the part, are in each joint referred to some particular spot. At the shoulder, this spot is in front, just below the acromion; in the elbow it is referred to the back part, where the radius is joined to the humerus. At the wrist, the pain is at the back, and outside of the extensor indicis. At the hip, if there be pain at the commencement of the disease, it is situated on the inside of the thigh, just behind the origin of the *gracilis*, and afterward shifts and fixes itself behind the great trochanter. At the knee, the pain is situated at the edge of the trochlear surface of the femur. At the ankle, in front of and below the external malleolus.

Although exceptions may occur to these rules, they are not sufficiently frequent to interfere with their practical value.

The spasmodic twitching or jerking of the limb is a prominent symptom in this stage of the disease, particularly of the hip, and is rarely absent in any case.

The constitutional disturbance resulting from loss of sleep and excessive pain soon manifests itself, causing impairment of the appetite, disorder of the secretions, constipation, high-colored, scanty urine, with more or less fever, followed at night by copious sweats.

The patient loses flesh and strength, becomes peevish and irritable, and his countenance assumes a care-worn expression.

The circumstance of an elongation of the limb in this stage of the disease, especially as regards the hip, is so constant as to be considered, in connection with other symptoms, pathognomonic, and has been accounted, for as resulting from an unusual secretion of the synovial fluid, by which the head of the thigh-bone is partially pressed out of its socket, causing eversion and abduction, flattening of the nates, flexion of the thigh on the pelvis, and of the leg somewhat upon the thigh—projecting the affected limb beyond the level of the sound one, from half an inch to even two and a half inches.

When the inflammation is acute, and the effusion of synovia into the capsular envelope is excessive, there will occur immobility of the joint, which may be mistaken for true or bony anchylosis; but division of the tendons of the contracted muscles, or puncture of the joint, will demonstrate its nature.

Other explanations of the cause of the elongation of the leg in hip-disease have been offered; and we know that frequently large accumulations of this kind occur in other joints, as the knee and elbow, without causing such elongation of the limb.

This swelling is caused by increased secretion into the synovial sac, and partly, though to a less degree, by the hyperæmia and effusion into the surrounding tissues. Each joint, becoming inflamed, assumes a certain position, peculiar to itself, which is an important aid to diagnosis. In such position only, thus assumed involuntarily by the patient, can he obtain any approach to ease and comfort. The experiments made by M. Bonnet, of Lyons, France, upon the dead subject, go to establish the explanation that the particular position assumed by each joint is that in which its synovial membrane acquires the greatest capacity of distention, and the limb, suiting its position to such distention, is placed in the position in which the effused fluid exercises the least pressure.

It was found by M. Bonnet, that when the synovial membrane of a joint was forcibly injected, the limb always assumed the same position, no matter what might have been its posture before the injection was performed; and such position of the joint was that which allowed of the greatest possible capacity to the synovial membrane, as was proved by the fact that, when the membrane was rendered tense by the injected fluid, forcibly changing the position of the limb caused the rupture of the membrane.

When synovitis affects the *shoulder-joint*, the swelling gives the deltoid a fuller appearance than natural, rendering less distinct and narrower the broad groove running downward from the acromion, and forming, as it were, a line of demarcation, separating the chest from the shoulder; the depression at the back, below the acromion, is also lost; the axilla is shallower, and when the surgeon places his finger in that cavity, and presses upward and outward, it causes pain.

The characteristic position in which the patient holds the arm, is to support the elbow in the hand of the unaffected arm, keeping it a little away from the side, and somewhat in front of the body.

Sometimes the bursa under the deltoid muscle becomes inflamed and swollen, which renders the deltoid more prominent than is the case in synovitis, and the other signs of synovitis are absent. In the bursal affection a crackling or fluid crepitus is felt, which is absent in synovitis. M.

Bonnet found that forcible injection of the synovial sac of this joint caused abduction of the humerus, until it formed an angle of 35° with the ribs, at the same time being carried forward.

Synovitis of the *elbow-joint* produces obliteration of the two depressions, one on each side of the triceps tendon and olecranon process at the back of the joint. The synovial membrane, being distended, rises high beneath the triceps tendon, and can be made to fluctuate from one side to the other, under it. A fluid enlargement takes the place of the depression, which should be felt between the radius and humerus, as is also the case with the depression between the internal condyle and olecranon, giving the joint the appearance of being broader than natural.

The characteristic position is, with the fore-arm bent at a little more than a right angle on the upper arm, and the hand in a position which places the thumb upward, the patient usually holding the wrist in the hand of the sound arm. Under the influence of forced injection, M. Bonnet found the ulna was always brought to stand at nearly a right angle to the humerus, and at the same time the radius was placed in a position between pronation and supination.

In acute synovitis of the *hip-joint*, it is more difficult, on account of the depth of the joint, to distinguish the swelling. When the fluid is considerable in quantity, some swelling may be felt on the inner side of the thigh, at its junction with the perinæum. Tumefaction is also to be seen and felt in the groin below Poupart's ligament, and also behind the great trochanter, the natural depression in this place being more or less obliterated. The pain, which in this seat of acute synovitis is so often very intense, is chiefly referred by the patient to the inner side of the thigh, where it joins the perinæum, whereas it is more referred to the knee in the chronic form of hip disease.

Generally the limb appears lengthened, and is a little flexed, abducted, and slightly rotated outward. The characteristic position is as follows: the thigh is bent on the pelvis, a little abducted and rotated outward. In lying down, the patient usually lies on the affected side, with the knee drawn up to an angle of about 120° with the body. When sitting, the patient leans with the elbow on the sound thigh, holding the knee of the affected limb in his hands, and supporting that foot across the foot of the sound limb. M. Bonnet found that forced injection caused the femur to bend at an obtuse angle to the axis of the pelvis, and at the same time it became abducted, and rotated slightly outward.

Inflammation of the bursæ, about the hip-joint, produces enlargement, and gives rise to symptoms which might simulate synovitis. One beneath the gluteus maximus muscle produces, when inflamed, tumefaction behind the trochanter, similar to that caused by synovitis, but the swelling is diffused over a larger circumference, and is not merely behind, but is also above the trochanter; it crackles on movement, and there is no inguinal enlargement from inflammation of this bursa.

There is a bursa situated between the conjoined tendon of the psoas and iliacus muscles and the bone, which sometimes becomes inflamed, in which case the resulting swelling and tenderness in the groin will very closely resemble the tumefaction arising in that locality from synovitis, but there will be no swelling behind the trochanter. When the hip-joint itself is inflamed, certain positions are less painful than others, but the difference is not nearly so perceptible as in inflammation of this bursa. If, in the latter case, the thigh be straightened on the pelvis, and rotated a little inward, the pain is intense; but if the thigh be much bent towards the abdomen, turned a little outward, and supported in this position, ease is at once attained.

Inflammation of either of these bursæ may thus be distinguished from synovitis of the hip-joint, unless the psoas bursa communicates, as it sometimes does, with the synovial sac. The synovial membrane of the shoulder-joint sometimes communicates with the bursa beneath the deltoid. Synovitis of the knee-joint is more readily distinguished, on account of the superficial position of the joint.

The tumefaction obliterates the natural depressions and elevations: the patella and its ligament, instead of forming a prominence, bounded by lateral depressions, lie in the midst of a puffy swelling, being almost concealed by the bulging out of the synovial bag at their sides. The swellings thus caused on each side of the patella and its ligament may be felt distinctly to fluctuate from one side to the other.

The patella itself is buoyed up from the femur and floats upon the accumulated fluid beneath, but may be made to resume its place, by slight pressure, between the femoral condyles. The fluid swelling rises up between the bone and the extensor muscles, as the synovial membrane, often in a healthy state, and always in this disease, extends very high. There is more or less fulness in the popliteal space when the synovia is quite large in quantity. The characteristic position of the joint is semiflexed at an angle of 120°.

M. Bonnet found also that forced injections into the synovial sac of the knee-joint placed the bones in this position.

In front of the knee-joint are two bursæ: a large one between the patella and skin, a small one between the ligamentum patellæ and the tibia above the tuberosity, which latter sometimes communicates with the synovial sac of the joint. The former bursa, when inflamed, causes a very prominent swelling over the patella, rendering this region markedly protuberant, whereas in synovitis it becomes concealed and less prominent.

Inflammation of the latter bursa causes but little swelling, confined on each side of the upper part of the tibial tuberosity, and the pain is quite limited.

In cases of synovitis of the *ankle-joint*, the tumefaction extends across the joint in the form of a half circle in front, extending from malleolus to malleolus, and also behind these processes of bone.

Fluctuation may be felt from one malleolus to the other when the effusion is quite considerable.

In acute synovitis of the *wrist-joint*, the swelling extends in a bracelet-like form round the back of this joint at a right angle with the long axis of the arm, and cannot, for this reason, be readily mistaken for enlargement of tendinous sheaths, the long axes of which latter are parallel with that of the arm.

In the *third stage* the symptoms become more aggravated and characteristic of the occurrence of suppuration within the affected joint, which by its pressure upon the inflamed structures greatly increases the suffering. The existence of this process is indicated by an increase of pain, deep and persistent throbbing and tension, increase of the swelling and œdema of the subcutaneous cellular tissue, and an enlarged and turgid condition of the subcutaneous veins. The inflamed joint will not allow of the least motion, much less any considerable manipulation, and the patient cannot move himself in bed without subjecting himself to the greatest agony.

Violent rigors, followed by high fever and copious sweats, almost invariably supervene as expressive of the constitutional disturbance, but the abscess may form in a quiet and insidious manner, without any of the severe symptoms which usually accompany the suppurative process; such exceptions are infrequent.

As the matter increases in quantity, it gradually works its way toward the surface; the skin over the whole mass becomes more markedly white and pearly, except one circumscribed spot where the abscess is about to point, which assumes an erysipelatous blush. Here there is generally distinct fluctuation, and the parts, feeling soft and boggy, soon yield at one or more points, followed by the escape of the contents of the sac.

The place where the abscess points is not a mere matter of chance; every joint has its particular locality for the discharge of pus, at which site it is more prone than at any other to point, so that the first opening which is made for this purpose nearly always occurs at the same place.

This pertains more especially to the deep-seated joints, the hip and shoulder. The choice locality for the former is just behind the great trochanter; for the latter, just inside the biceps, below the pectoralis major muscle. So constant are these the places respectively that we might conclude, if a first abscess should open at some other site, that it had formed in the substance of the tissue not communicating with the cavity of the joint. Occasionally, at the hip-joint, the matter escapes at several points, as at the superior and external part of the groin, the sacro-sciatic notch, or the upper and inner surface of the thigh, leaving thus a number of orifices leading to a corresponding number of sinuses, which passages are sometimes very long and tortuous, and, in old cases, are always lined by a false membrane. In some cases the matter has been known to escape both externally and internally, and, from erosion and perforation of the acetabulum, may find its way into the rectum, or burrow between the pelvic bones and soft tissues. In both sexes it has been known to escape by the bladder, and in the female by the vagina.

The appearance of the pus discharged from the diseased joint is similar to that from a cold abscess, being more fluid than ordinary pus and of a more greenish hue, and is often commingled with small whitish particles, somewhat resembling particles of boiled rice; also with flakes of lymph, or perhaps small clots of blood, especially when the preceding inflammation has been very severe, or the parts have been subjected to rough handling. All those cells in the focus of suppuration which can be converted into or generate pus-cells are liable to be so affected, and the parts slough, the pus containing the *débris* of ligamentous tissue, articular cartilage, and bony substance in the form of fine detritus.

When the disease has progressed so far as to implicate the cartilages and bones, the symptoms of ostitis override and mask those of mere synovitis. Occasionally, though rarely, large pieces of bone are discharged. The pus, when long confined, is often very fetid, and is always so if, in consequence of its burrowing and opening into the bowel, it is mixed with fecal matter.

When the abscess has once fully emptied itself, the discharge subsequently occurring is often ichorous, gleety in appearance, or thin and bloody, and the quantity may be very small, or so profuse as to exhaust the system. Whenever the discharge is unusually protracted, especially if it is occasionally mixed with little granules of a whitish gritty character, it may safely be assumed that there is caries of the bony structures of the joint

After the suppurative action is established, it has no special limit to its duration. At times it may be almost entirely suspended, perhaps for months, when it again reappears and becomes as profuse as before.

The discharge from hip-joint disease has been known to maintain itself for two years, with scarcely any interruption.

Should no arrest of the disease be effected, constitutional symptoms, as of hectic, will appear, and impaired sleep and copious sweats at night, rapid emaciation, decline of strength and colliquative diarrhœa will exhaust the patient.

Sometimes, in apparently desperate cases, reaction takes place, followed by ultimate recovery.

Suppuration does not always take place in this stage of this disease, at least to the extent of producing its characteristic symptoms. The greatest ravages, as the complete disappearance of the articular cartilages and ligaments, and even the destruction, more or less, of the bones of the joints, have occurred independently of the suppurative process.

Abscesses forming external to the joint almost always communicate with the cavity of the joint, which is thus opened upon the opening and discharge of the abscess, and the structures over and around the joint, participating in the inflammatory action, become as it were hypertrophied from interstitial deposits.

In the case of the disease affecting the hip-joint, the changes in the limb and hip in this stage, after the rupture of the capsule, are very striking and characteristic, and the suddenness of the occurrence has led to the idea that luxation had happened.

The change from the second to the third stage is sudden when the opening in the capsule is large and allows of the total and rapid escape of its contents, and gradual if the opening is small, in which latter it may require weeks to effect the change which has been known to occur in one night in the former.

The position of the limb is now almost the reverse of what it was in the second stage: is actually shorter than natural; is much attenuated from the wasting of its fatty and muscular tissues, and materially disfigured in its appearance, the heel being considerably elevated, and the ball of the foot and toes alone touching the ground when the patient stands.

While in some instances the degree of shortening does not exceed an inch, in others it may amount to three times that extent, and is by no means in proportion to the destruction of the head and neck of the thigh-bone, acetabulum, and the connecting ligaments. A considerable proportion of this shortening is undoubtedly attributable to the elevation of the pelvis on the affected side. The foot also varies in position, sometimes being placed directly forward, but more generally it inclines inward, though it may incline outward, which changes are ascribed to the extent and nature of the ravages sustained by the hip-joint.

The foot usually inclines inward, as in dislocation of the femur upward upon the dorsum ilii, when the acetabulum has suffered very severely; but the foot is generally everted, as in fracture of the neck of the femur, the external rotatory muscles tending to draw the whole limb in that direction, when, on the contrary, there has been much destruction of the head and neck of the femur, and the acetabulum is slightly involved. There are extreme cases, where the head of the femur has broken through the acetabulum, by which it is firmly held, in which these changes may not take place; but, as a general rule, the thigh is flexed upon the pelvis at a very slight angle, varying to 45°, and inclines toward the sound limb, which it occasionally overlaps.

In consequence of the contracted state of the muscles of the thigh, and the existence of adhesions between the diseased head and neck of the femur and the surrounding tissues, the limb is almost always in a painfully rigid condition. A slight degree of flexion of the knee may perhaps be produced, but abduction of the thigh, or moving it backward, is generally attended with such extreme suffering to the patient as to render such movements impracticable. The hamstring muscles being also contracted, the leg is flexed upon the thigh more or less, and the heel is drawn upward toward the leg. The position of the great trochanter is directly over the acetabulum, forming a nearly immovable prominence, in consequence of the almost complete wearing away of the head and neck of the femur and the retraction of the muscles, drawing the remnant of its head high up (into the cotyloid cavity). It is generally allowed that dislocation of the femur, during the progress of hip-disease, is very rare, and where such happens to be the case, it will be found that, in consequence of the destruction of the upper border of the acetabulum and shortening of the head of the femur, it is drawn backward toward the sciatic notch, downward and forward into the thyroid foramen, or forward upon the pubic bone; but displacement in these directions can only take place where there has been extensive suppuration with separation or destruction of the soft parts, allowing the decimated articular extremity of the bone to move about and adapt itself in some new position.

The displacement upward is the most liable one, but even this is extremely rare. The destruction of the head and neck of the femur, with more or less corresponding degeneration of the cotyloid cavity, together with a certain degree of elevation of the corresponding hip, is usually the cause of shortening of the limb in the third stage of morbus coxarius.

As the result of these retrograde processes in other joints, the bones become capable of abnormal postures: the tibia, for example, may be rotated upon the femur in such disease of the knee-joint, and may become drawn back by the action of the flexor muscles; the ulna may be shifted from side to side over the trochlear surfaces of the humerus, and the radius is liable to be drawn upward by the biceps, in this affection attacking the elbow-joint, but such displacements, however, are rarely to the extent of constituting actual dislocation. Such displacements are followed by an *entire cessation of pressure of one articular surface upon the other, and are followed by a remarkable remission of the starting pains which produce so much distress.*

This cessation of pain, resulting from separation of the impinging surfaces within the diseased joint, is the most important of considerations connected with the semiology and treatment of this disease, and will be found more fully discussed elsewhere.

DIAGNOSIS.

The *diagnosis* of synovitis is not usually difficult, when it is uncomplicated with other diseases of the joint or of the surrounding parts. In all its forms, the synovial sac, at periods varying according to the degree of the inflammation, becomes more or less distended with effused fluid. If the joint involved is the knee, the synovial sac will, as the result of its distention, protrude between the articular extremities of the bones, and the patella will be raised from its proper position, and by slight manipulation can be made, as it were, to float in its fluid bed, especially if the leg be moderately extended and the hand be placed over the condyles of the femur.

If the leg is placed in a somewhat dependent position, the fluid will gravitate so as to protrude the synovial sac upon either side of the patella and its lower ligament. This physical symptom, the distention of the synovial membrane, is manifest in joints well exposed to observation. In the elbow, wrist, ankle, and smaller joints, it will protrude between the articular extremities, yielding a sensation of elasticity to the touch, according to the degree of distention. This distention is not so evident in the shoulder and hip, and more dependence must be placed upon the general symptoms.

When affecting the shoulder, the joint may appear, as compared with its fellow, more full and round, and pressure made anteriorly over the bicipital groove or posteriorly below the root of the acromion process will discover more or less distention, and pain will be produced by pressure and manipulation, proportionate to the severity of the inflammation.

In the hip, the leg will be generally partially flexed upon the pelvis and rotated inward; attempts at movement will produce pain, and, if looked for, an inordinate degree of fulness will be observed below the groin, over the insertion of the psoas muscles, or posteriorly behind the greater trochanter, and pressure upon these spots will produce pain.

This disease is liable to be erroneously diagnosticated, notwithstanding the symptoms are usually well marked, especially after it has progressed for some time.

A sudden wrenching or contusion of the hip, if followed by considerable inflammation, will give rise to pain and stiffness, which may seriously interfere with walking, in attempting which the patient raises the hip of the affected side, and relaxes the leg by bending the knee and retracting the heel, as in the earlier stages of morbus coxarius; the muscles gradually become attenuated, and the temperature of the skin over the thigh becomes sensibly diminished. The gluteo-femoral crease may in time become obliterated, and the general health itself may become materially affected.

Although such injury may eventuate in rousing the latent tendency to synovitis, yet where this has not occurred, the history of the case, the absence of pain in the knee, and the greater scope of motion to which the limb is susceptible, will aid in determining its nature. In strumous synovitis of the hip-joint the foot is quite firmly fixed, whereas, under the circumstances now contemplated, it admits of free rotation on its axis.

Chronic and *Subacute Rheumatism* of the hip-joint generally results from cold and sudden suppression of perspiration, and is principally seated in the synovial and ligamentous structures, the osseous and cartilaginous tissues escaping, except in very severe and obstinate cases. The pain is dull, heavy, or aching, and runs down the front of the thigh. In walking, the patient limps; in standing, the pelvis is higher than on the sound side, and the affected limb assumes a position similar to that attendant upon local injury, except that the foot is strongly everted in the rheumatic difficulty, but inclined inward in cases resulting from injury. As in other rheumatic affections, there is stiffness of the limb in the morning, which abates after exercise, but returns again. The muscles of the thigh may become attenuated, but not so soft as in strumous disease of the joint, while those of the leg usually remain normal; the gluteo-femoral crease becomes effaced, and, in consequence of the obliquity of the pelvis, the leg is considerably shortened, the great trochanter being quite prominent. If the head of the thigh bone be forcibly moved upon the acetabulum, a creaking noise may be produced. The differential traits between this and the strumous disease are the absence of severe pain at night, and the non-appearance of it at any time in the knee; the marked improvement for the time, caused by moderate exercise; the slightest, if any, aggravation resulting from percussion or even rough examination of the limb, andthe frequent coexistence of rheumatism in other parts of the body; besides the rare existence of rheumatism in children as compared with the very frequent occurrence of the strumous disease.

In *Psoas Abscess* the swelling is usually above Poupart's ligament, but in strumous disease of the hip-joint it is commonly below. In the former, the swelling receives a distinct impulse on coughing, laughing, and crying, which does not occur in the latter. In psoas abscess the swelling always diminishes, and sometimes entirely disappears under pressure, or when the patient lies down, but soon reappears when the pressure is removed, or the patient gets up. In strumous synovitis of the hip-joint it does not change its position, unless from the slow process of ulceration. In this affection, the pain is most severe in the knee, or in the knee and hip; but in psoas abscess the pain is mostly complained of in the loins, and is always increased by the erect posture and by every attempt to extend the corresponding leg.

In psoas abscess there is no alteration of the length of the leg, nor any change from its natural position of the great trochanter, whereas such changes are important facts connected with the disease of the hip-joint.

While psoas abscess occurs generally after puberty, the disease of the hip-joint is confined with equal strictness to early childhood, though both may occur at any age.

Other abscesses, from injury, or phlegmonous state of the system, may occur and point in the vicinity of the hip-joint, resembling abscesses from strumous disease of the joint, but they may be diagnosticated by their rapid culmination and the prompt recovery of the parts after they are discharged.

Should abscesses depend upon caries of the pelvic bones, an exploration with a probe will be necessary to determine it. All inflammatory diseases of joints, and particularly of the hip-joint, originate either in the bone or the synovial membrane, and in the early stage osteitis and synovitis may be distinguished from each other, but the ability to diagnose one from the other rarely extends beyond the latter end of the first stage.

During this early period, the pain in synovitis is more a sense of fulness, the distention being increased in the evening and after exercise, but remains constant, whereas in osteitis the pain is dull and aching, occurring more at night after the patient is in bed, and is remittent.

In synovitis, there is more stiffness of the part in the morning, but in osteitis this is not the case.

In synovitis, limping comes on with the pain; is at first slight in the morning, then disappears, and afterward reappears in the evening; but in osteitis the limping does not come on till after the pain has existed some time, and is then persistent and equable throughout the day.

In synovitis, the pain in the knee does not come on until after the deep swelling in the groin has made its appearance, whereas in osteitis the pain in the knee is an early symptom.

In synovitis, starting of the limb is a late symptom, as compared with its appearance in osteitis, it coming on quite early in the latter complaint.

In synovitis, there is tenderness behind the trochanter and at the groin, but more at this stage on pressing the articular surfaces together, whereas in osteitis there is no tenderness on pressing behind the trochanter and upon the groin, but sometimes on pressing the articular surfaces together.

In synovitis, the swelling in the groin is deep, and is situated below Poupart's ligament; but the glands there do not swell.

In osteitis, the glands in the groin swell before any deeper swelling is perceptible, if ever such swelling makes itself noticeable in the first stage.

Periostitis of the femur may give rise to symptoms very nearly simulating those of coxalgia, especially if the periosteum covering the great trochanter be the seat of the disease.

This usually supervenes upon a rheumatic or gouty habit of the system. The fibrous membrane of this portion of the femur becomes excessively painful and tender to the touch, any effort at manipulation of any kind causing most severe pain. As the inflammation progresses, the capsular envelopes of the joint become involved, and difficulty and pain in walking ensue, together with elevation of the hip of the affected side similar to that occurring in strumous synovitis. The inflammation of the periosteum causes considerable tumefaction of the hip, and, as suppuration progresses, sinuses form, through which may come away small portions of the bone.

The diagnostic symptoms are the fact that periostitis usually comes on suddenly; while the strumous synovitis in this the third stage, which it is liable to simulate, has gradually grown out of the preceding stages.

In synovitis, the gluteo-femoral crease is effaced, but it is not affected by periostitis.

In synovitis, the femur is not enlarged, but is more or less in periostitis.

Periostitis usually occurs later in life than synovitis, and is generally complicated with rheumatism or gout.

In periostitis, the femur is painful on pressure; but in synovitis there is no such complaint.

In periostitis, the hip-joint is free; but, in the strumous disease, the joint is almost fixed, and when moved, often imparts the sense of crepitation.

Sacro-iliac disease may be mistaken for strumous synovitis of the hip-joint, in the first and second stages of which latter there is elongation of the limb, which always occurs in sacro-iliac disease.

In synovitis, the elongation of the limb is caused by effusion into the hip-joint, and is ascertained by measuring from the anterior-superior spinous process of the ilium to the internal malleolus. When the disease is in the hip-joint, the measurements will be unequal, but, if the disease be between the sacrum and ilium, this measurement between the superior iliac spines on either side and the malleoli will be equal, and the elongation will depend upon displacement of the diseased ilium itself, which is tilted forward, and rotated or pushed downward, owing to the diseased action going on in the sacro-iliac articulation.

The anterior spine of the affected ilium is lower down than its fellow, and is pushed forward quite prominent; but this is caused by the tilting forward and rotation downward of the whole of the diseased side of the pelvis, and not by obliquity of the pelvis consequent upon a twist of the spine, as in disease of the hip-joint.

The seat of pain in the two affections is different. In the disease of the hip, the pain is most acute upon pressure being applied above and behind the trochanter major, or when pressure is made against the anterior part of the hip-joint, through the pectineus muscle; whereas, in the sacro-iliac disease, no pain is caused by pressure made in these situations; but pressure upon the sacrum and along the line of the sacro-iliac junction, behind and altogether away from the hip-joint, will give rise to pain and tenderness.

In sacro-iliac disease, when the patient is placed on his back, and the pelvis securely held by an assistant, the thigh may be moved in all directions without any increase of pain, as long as the pelvis is held immovable.

In hip-disease, abduction or rotation outward aggravates the sufferings of the patient.

To properly examine a case of strumous synovitis of the hip-joint, the patient should be completely stripped, and viewed both in front and behind, as he stands on the floor.

If there be any flattening of the nates, change in the gluteo-femoral crease, or unusual prominence of the trochanter, and if there be any alteration in the attitude, size, or length of the limbs, it may be detected; and if the patient walk around, the amount of limping will be noticed, and also the manner in which he raises and moves the leg and foot. The patient should then be stretched out on some flat surface, to ascertain the amount of pain produced by rotating the head of the thigh-bone upon the acetabulum, and also by bringing these parts forcibly into contact with each other by percussing the knee, the leg being flexed, or the sole of the foot of the affected limb being placed upon the opposite ankle.

The patient is then turned upon his abdomen, and the hip examined as to the condition of the soft parts, and the presence of obliquity of the pelvis, which may appear either in the recumbent or erect position. Change in the length of the limbs may be discovered by measuring from the anterior-superior spine of the ilium to the inner side of the lower extremity of the patella. Where the parts are very painful upon manipulation, it may be advisable to put the patient under the influence of chloroform.

PATHOLOGY AND MORBID ANATOMY.

In the different stages of its progress, this disease exhibits variations in the morbid changes. Comparatively little is known of these changes in the incipient stage, as the disease rarely proves fatal at this period, and what has been ascertained has been the result of accident; but still enough has been gathered to show that the morbid changes induced at this early period are similar to those of ordinary inflammation.

The synovial membrane, which is usually the first tissue involved, shows evidence of slight vascularity, being somewhat opaque, and slightly softened at certain points, with a few straggling blood-vessels, more or less engorged, upon its surface. A deposition of lymph may occur at quite an early period, giving to this membrane a thickened filamentous appearance, and the deposit soon assumes a pulpy consistence, of a pale yellow or greenish color. If the articular cartilage has become seriously involved in the inflammation, it will be found of a slightly grayish or dull-white appearance, more or less softened and thickened, and perhaps somewhat separated from its attachments to the bones.

The bones may be easily cut or broken, in consequence of the cancellated structure having become unnaturally porous, vascular, and humid, and sometimes its cells are filled with tuberculous matter of a caseous consistence, and yellowish color, or it may present itself in distinct minute masses; and these changes are more apt to be found in the head and neck of the femur than in the pelvic portion of the articulation, the latter being seldom affected at this early stage of the disease; but the round ligament generally suffers early, being tumefied, red, and softened. The synovial fluid is also somewhat increased in quantity, but not to any very considerable extent.

As the disease advances, these morbid changes become more apparent, and the degenerating process becomes more strongly marked throughout the whole joint.

The exudation of lymph increases and becomes more or less mixed with sero-purulent matter, or thick pus, of a greenish tinge. The synovial membrane has become partially destroyed, and the remainder is ragged in appearance, opaque, and muddy. The cartilage may be almost entirely separated from its osseous attachments, discolored, pulpified, and perforated. The bony structure is easily broken down, being carious, rough, quite red, and soft. The capsular investment of the joint and the cotyloid ligament shows the effects of the inflammation, being abnormally thinner at one point and thicker at another, loose and spongy; and the round ligament also only retains a vestige of its normal status.

The disease having reached its height, the structures of the joint are so far destroyed as to leave little of their original appearance, and pus is now seen frequently in large quantities, sometimes of a thick, caseous consistence, more or less sero-sanguinolent or ichorous, but more generally having the appearance of strumous matter. The head and neck of the femur, with the articular cartilages, the synovial membrane, the round ligament, and the bottom of the acetabulum are partially, if not wholly, destroyed; and in the severest cases the transverse, cotyloid, and even the capsular ligament are obliterated, the surrounding parts being extensively separated by the ulcerative and suppurative processes.

Fistulous openings exist, and the gluteal muscles present firm, dense bodies of a pale color, with a reddish, whitish, or yellowish tinge, or they may have undergone, in long-standing cases, the fatty degeneration.

The degenerative processes may have gone so far as to have resulted in annihilation of both trochanters, also inducing caries of the hip-bone, and necrosis of the thigh-bone, and the matter in the cavity of the joint will contain fragments of bone and cartilage. If the bottom of the acetabulum has been perforated, pus will escape into the pelvis, and escape, in the male, by the rectum, or, in the female, by the vagina.

Sometimes the hip-bone is found separated at the acetabulum into its three original pieces, when the disease has extended thus far previous to the period of complete ossification. Upon dissection, the remnant of the upper portion of the femur is generally found lying across the acetabulum, or in its vicinity, or may be drawn up slightly beyond this cavity against the surface of the ilium, where it may have formed a depression, having some resemblance to a new socket.

It may be found forced backward into the sciatic notch, or forward upon the pubic bone, or downward into the thyroid foramen; but such instances are very rare. The head of the femur may be found forced through the cavity of the acetabulum, where the ulcerative and suppurative processes have principally expended themselves upon this cavity, and in extreme cases, *in transitu*, where this has happened, the change from the second to the third stage of the disease will not be so apparent as when the synovial sac has been freely ruptured, the head of the femur being impacted, and held firmly by the rim of the surrounding bone, the contents of the synovial sac gradually and partially escaping through the fractured cavity into the pelvis.

The extremity of the femur may be found firmly attached to the surrounding structures, or anchylosed, in cases where a process of recovery has been instituted before death, and the acetabulum will be found occupied by a white, fibrous, organized substance. That a substitute for a socket may be formed, has been proved by dissection, but such an event is rare.

Where it does occur, as in persons who have recovered from the disease, the limb will be much restricted in its movements, and materially shortened. It may be that some progress has been made toward repairing damages by the formation of a ligament around the bony remnant of the articular end of the femur, which may also be covered partially by cartilage, there being also irregular depositions of osseous growth upon the approximating surfaces of both the hip and thigh bones.

Examination of the bodies of those who die of strumous synovitis, or while affected with it, generally shows pathological changes, directly resulting from the tubercular cachexia, of which this disease is one of the local effects; the most usual concomitant effects are tubercular deposits in the lungs, tuberculization and enlargement of the bronchial ganglions, and also of the peritoneum, and in children, strumous deposits in the lymphatic ganglions of the pelvis and mesentery.

There may also be dropsical effusions, especially in the cavity of the peritoneum, and adhesions may occur between the lung and costal pleura, with or without serous and other effusions.

Sometimes strumous deposits are found in the spleen, and the liver is often cirrhosed and enlarged, and the glands of Peyer are occasionally ulcerated.

In cases where the acetabulum has been perforated, allowing the escape of pus into the cavity of the pelvis, the matter will often be found to have made its way through the colon, the rectum, the bladder, or the vagina, or to have extensively burrowed among the muscles surrounding the hip, where free vent has not occurred by spontaneous or artificial opening, in cases where it has escaped into the tissues exterior to the pelvic cavity. In long-standing cases, where there is strumous disease of other parts, the extremities, the face, and even the genital organs may have become œdematous, showing the depraved and impoverished condition of the blood, which is especially deficient in fibrin and coloring matter.

The reader can in the preceding pages get a very good idea of what the books say upon this subject. We have arranged alphabetically all the localities possessing synovial membrane. We have also given the position assumed when these membranes are inflamed, but more particularly when effusion has taken place into these cavities.

Inflammation of this membrane is often but the first step in the destructive process that is to follow; therefore, it is represented as running into the destruction, or rather, that the destruction is in consequence of the primary synovitis.

Before giving the plan of treatment which we have brought to the notice of the profession, we will comment upon a few points as they occur in the preceding pages.

In what proportion the knee is affected.—The knee-joint is said to be affected by inflammation of this membrane in the proportion of three to one. The knee, in communities where the occupation of the inhabitants would render them liable to traumatic injuries, may be much more subject to inflammation of this kind, among adults, but we have seen a far greater number of cases among children where the hip has been the seat of the disease, but disease of the hip is much more common at the present day than formerly.

Extension of the inflammation.—The inflammation is said to extend from the bursa to the joint. This may be true in those cases where the bursa inflamed communicates with the joint. We consider it fully established, that when disease *about a joint renders the movements of that joint painful, that the joint is always liable to be destroyed by uninterrupted pressure effected through the contraction of the muscles passing over it.* They do this by preventing the parts pressed upon from receiving nourishment, in the same way as a bed-sore is produced. This view was first brought to the notice of the profession in a paper read by us before the New York Academy of Medicine, in 1860.

Office of cartilages.—In addition to their anti-friction qualities, we are of the opinion that cartilages perform an important function in preventing concussion. In this respect they possess almost the qualities of rubber. This is probably a more important function than the other, as the surfaces of smooth bones would work together without friction, if lubricated with the synovial fluid; therefore, cartilage would seem to have some other function in the animal economy beside that mentioned by authors.

Source of nourishment.—The destruction of cartilage by pressure takes place first upon its outer surface, and then extends downward and outward as the pressure is continued. Whereas, if it received its nourishment from its outer surface through the vessels of the synovial membrane, these vessels would be affected first by pressure, and when these were destroyed the parts below would be dead, because their source of life was cut off. Again, it is evident that the synovial membrane does not cover parts subject to the severe pressure that exists between articulating surfaces, from the care that is taken, by means of special contrivances, for the very purpose of preventing its folds from being caught between the ends of the bones. This would appear unnecessary, if the membrane extended over the whole articulating surface.

It seems necessary to state that a large part of the symptoms and the condition of joints given by authors are the result of the disease being allowed to progress, *aided at the same time by the pressure from contraction of the muscles.* If our mode of treatment by *continued elastic extension* were adopted from the first access of the inflammation, the effects enumerated would not be found.

Rigidity of muscles as a diagnostic symptom.—Stiffness of the muscles cannot be considered a diagnostic symptom of rheumatic inflammation, as it occurs in all diseases of joints, in the hip, knee, and vertebræ, etc., and may more properly be considered a symptom of some affection of the joints, rather than that of any particular form of disease.

We have drawn this gloomy picture from authors of the effects of this disease, in cases primarily grave, or of others more mild, that have been badly treated, that the reader may distinctly perceive what has been encountered by the practitioner, and what has been endured by the patient under the former plan of treatment, in order that he may the more fully appreciate the untold advantages arising from the mode of treatment we have practised for the last fifteen years. Well has the latter been termed one of the greatest discoveries of the century, and, as was remarked during the discussion upon morbus coxarius at the New York Academy of Medicine by one of its members, "if there was no other advantage arising from it, the relief it affords to the pain would render it invaluable." As desirable as it is to relieve pain, and as beneficent as it is in a general sense, it is nothing in comparison with the fact, that this treatment by "continued elastic extension" often saves from destruction every part of the joint; and, when the constitution is so extremely depraved as not to admit of this result, it maintains the limb at its full length, keeping what may remain of the neck at or below the acetabulum, that, when the ulcerative process has subsided, a new joint may be formed, but little inferior to the original, and with a limb nearly of full length. This, although so gratifying and encouraging, is but a part of the sum total of the blessings which this mode of treatment would confer, were it *adopted from the first.*

When "*elastic extension*" is *properly applied*—and when we use the word *properly*, we use it as covering a variety of circumstances; for when improperly applied it may only aggravate all the symptoms, and prove a curse rather than a blessing—as we said, when "*continued elastic extension*" *is correctly applied*, there will ensue perfect relief from pain, followed, in from one to three days, by a great diminution of the soreness and tenderness. As a consequence of this freedom from pain and tenderness, the appetite improves, the patient obtains quiet and refreshing sleep, becomes cheerful and hopeful, in short, begins to enjoy life with a new zest.

With this result as a consequence of our mode of treating this disease, what is to destroy life? It directly affects no organ whose function is essential to life. The suffering is relieved, and there need not be sufficient discharge, even in the worst cases, to exhaust the system; the appetite returns, and ordinarily the power of assimilating the food. Again, we inquire what there is in a case of morbus coxarius, or in the ulceration of any of the joints, to destroy life, when the treatment by "*continued elastic extension*" is practised from the commencement? We can see no reason, neither has our experience, covering as it does a period of many years, presented a single instance to lead us to doubt this conclusion. We think the time is not far distant when our professional brethren will fully agree with the statement we made in 1860, before the Academy of Medicine of this city, viz.: that a patient ought never to die from the direct effect of either morbus coxarius, white swelling, ulceration of the vertebræ, or of any other joint.

When we contrast the loss of life, the almost intolerable suffering, running often through a period of years, the shortened, contracted limb, with an immovable condition of the hip-joint, the unnatural movement of the body in walking, rendering locomotion fatiguing, not to mention the mental suffering arising from possessing so disagreeable a deformity—when we contrast all this, we repeat, with the certainty of life, the freedom from pain, the enjoyment of almost every thing that goes to make life pleasant, the recovery with a limb of full length, normal in position, a joint that performs all its functions, and the consequent freedom from the mortification attending an unsightly deformity, we can begin to appreciate the advantages and the blessing conferred by the introduction of the treatment of this class of diseases by "*continued elastic extension.*"

The treatment of simple synovitis, in its earliest stages, by extension, is as imperatively demanded as at any later period, and relieves the pain as effectually. It has been stated by some professors in our colleges, and by others, that this mode of extension was of no advantage before shortening had taken place. We wish to correct this error, and to state most *emphatically*, that continued elastic extension *is applicable not only to synovitis, but to all other diseases within the capsule; and not only there, but when parts about or in the vicinity of a joint are so painful as to compel the individual to hold the joint motionless, extension should be applied, for the reason, that the pressure exerted by the muscles in holding the joint motionless will strangulate the nutrient vessels of the parts held in contact.*

To illustrate the relief afforded by the application of continued elastic extension in the acute stage of synovitis, we give the following case:

In February, 1861, we were called in council to the daughter of Mr. S.; her age, fourteen; general health had been good; was attending school. She remarked to her mother one morning, as she was ready for school, that her hip pained her, and that it had pained her the previous morning. It was not sufficient, however, for her to suggest staying at home. She walked to school as usual, without limping; the pain continued to increase so rapidly that at noon she was sent home in a carriage, being unable to walk. The family physician was called, and applied counter-irritation, and administered some medicines. The pain and tenderness increased rapidly, depriving her of sleep; the limb became flexed close to the body, and adducted. There being no improvement, or mitigation of the pain, after a few days a prominent surgeon was called in council; he forcibly straightened the limb, the operation producing intense agony. On the tenth day from the attack we were called. At this time she was suffering intensely, had been unable to obtain any rest, although she had received the night previous eight grains of pure opium.

We applied the adhesive straps, and while the weight was being attached to the cord, we made extension with the hand; she ceased her complaining, and when the weight was adjusted we went to her to inquire how she felt, and found her so soundly asleep that our voice would not wake her. The relief from the most intense suffering was immediate.

The whole region of the hip-joint was very much swollen, excessively tender, and perfectly intolerant of motion.

We directed a succession of small blisters to be made, with the chlorid. hydrg. corros., of the size of a dollar, and continued them until there was a slight effect upon the mouth, though this was not our intention, and we always dislike to see it.

The inflammation had advanced so far that it was some months before she entirely recovered, but eventually did, with a good joint. The probabilities are that, without this mode of treatment, she would have run through all the stages of morbus coxarius, eventuating in a shortened limb, and fixed state of the joint, if she escaped with her life. This result was prevented by the extension separating the impinging surfaces, and preventing their destruction by pressure; it is probable, however, that in this case the treatment had been delayed until a certain amount had been accomplished, for the limb had the appearance, after the active inflammation was subdued, of a case of morbus coxarius.

We have never found any external application to equal this preparation of mercury, but it must be applied liberally. It generally expends its force locally, producing rapid absorption of any effused fluid, and at the same time allays the inflammation.

This application will seldom affect the mouth, if applied during the active stage of the inflammation.

The constitutional treatment, we have given more fully under the head of morbus coxarius.

MORBUS COXARIUS.

So much has already been written upon this subject, and so many have sought to establish popular reputations by erecting beacons along this path of science, that we hesitate, and would not enter upon its consideration, except to vindicate our priority to the discovery of the true pathology of this disease, and also the only correct principles of its treatment.

We have given to the profession at large *immutable principles*, which govern all diseases of the joints, and their treatment, hoping that every well-informed physician and surgeon could apply them, and would, at the same time, cheerfully acknowledge from whence they were derived, and give us the credit.

In this, however, we have been somewhat disappointed.

Almost all who have applied the *principles* we have laid down, although perhaps under circumstances not particularly described by us, have claimed the entire credit, and reported their cases as though the application of our discovery in a modified form gave them a right to its originality, instead of the application or modification of it .

In diseases of joints, we were the first to point out, as an always-present factor in their destruction, the existence of unremitting pressure, as effected by contraction of muscles passing over the joints, causing constant forcible apposition of the surfaces within the joint.

This is a general principle, appertaining not only to the hip, but to all joints similarly affected.

The application of this universal principle should guide us in any joint affection, whether the disease be internal or external, as soon as the disease renders the movements of the joint painful.

When this fact was fully established in our mind, we were led to seek the best way of counteracting the contraction of the muscles, and soon came to the conclusion that a constantly acting force, however moderate, must eventually weary muscles, by giving them no respite.

We adopted the weight, as applied by means of the cord, pulley, and adhesive strips for this purpose, when the patient was confined to the bed or couch. This answered the indication perfectly, relieving all pain and constitutional disturbance; enabling the patient to enjoy his days free from pain, and to rest quietly at night, to relish his food, and to be nourished by it—in short, it robbed the disease of all its terrors.

It soon became evident that, if this principle of *continued elastic extension* could be so applied as to allow the patient to walk and ride, and take out-door exercise, we should not only add to his comfort and happiness, but it would aid in invigorating the system, thereby enabling it not only to resist the disease, but to repair the injury which might already have been inflicted.

With this object in view, we invented originally a wooden splint. With this, the extending power was regulated by altering, by a strap and buckle, not only the perineal band, but the band attached to the adhesive strips at the bottom. This we used a year or two, and substituted for it one made of corrugated steel (See Cut No. 1 of Splint), with double lever or elbow-joint. In this the extending force was regulated by altering by a strap and buckle, the same as in the wooden splint, with the addition that, by means of the joint in the centre of the splint, the surgeon could shorten it, so as to render the straps more easily adjusted; and when brought into a straight line, sufficient extension being made, the position of the splint was secured by means of a steel slide.

This constituted a very simple and effective instrument, embracing all the principles indicated, for the successful treatment of the pathological condition of the joint; and all alterations which have since been made have been simply modifications, without in any way affecting *the principle we originally instituted.*

This last-mentioned splint was made in 1855.

Since then we have made about twenty different modifications, all based upon the original principle.

All these different appliances maintained *continued elastic extension* by means of an *elastic perineal band*, overlapped by an *inelastic band*, so arranged upon the patient, that when extension is made upon the limb, and the elastic band is stretched, the inelastic band, being tense, prevents the instrument from yielding, when more pressure upward is applied to it than the elastic band can resist; were it otherwise, the head of the femur might be forced higher up into the socket, by the weight of the patient coming suddenly upon the affected limb. This inelastic band acts as a safeguard, effectually preventing the parts of the joint from impinging upon each other.

The first splint, as well as all my modifications, admits of free motion of the diseased joint, but rigidly excludes all friction of the diseased surfaces within the joint, upon each other.

This we consider the essential element in the treatment of the disease under consideration, viz.: *motion without friction*, for no portion of the anatomy requires motion to maintain integrity more than the joints, and the pain could scarcely be more unendurable than that occasioned by friction of the surfaces within the joint when those surfaces are in the condition characteristic of morbus coxarius.

Most of the modifications of my instrument, made by others, have no guard in the form of a second inelastic band in the perineum. Not understanding its object, they leave it off in their alterations, thereby leaving the head of the femur liable to be forced against the upper portion of the acetabulum, whenever, from any cause, more weight is thrown on the elastic perineal band than it can resist, as might happen to the patient in making a misstep.

Again, many of them, not understanding that motion without friction is important to a healthy condition of joints, apply, with their instruments, a strap around the knee in this affection, and attempt to confine the whole limb, in conformity with the old idea, which so long governed the medical profession, of obtaining *perfect rest* of the injured or tuberculous articulation.

We also introduced the use of *twilled goods* for spreading the adhesive plaster upon. The twilled material yields moderately in every direction, upon the plan known among dress-makers, who cut plain woven goods biasing, when desirous of warping it into certain irregular shapes. The twilled material allows the plaster to adhere to an uneven surface, and when extension is made at the free end, the plaster yields only sufficiently to distribute the draft equally throughout every part of that portion attached to the skin.

Again, we first made known to the profession that the plaster should be kept until the oil entering into its composition has become a resin, by oxydation; otherwise, if the plaster is applied fresh, particularly in warm weather, the oily secretions from the skin will unite with it, and soon will render it so soft and unctuous that it will slide off. When oxydized, this will not occur, and when once adherent to the skin will hold until the epidermis is loosened. We have had it remain on a patient seven months. To apply this old plaster, it should be lightly touched with spts. turpentine, making the surface slightly adhesive, or it can be heated very hot and applied when it is so far cooled as not to burn; but, in whatever way it is first applied, it should remain on two or three hours, with the patient warm in bed, before any traction is made upon it.

We were the first to make and use a splint which allows of extension being made from the thigh only, and have so used it in cases from puberty upward, but we prefer the long splint, with the exception that it does not admit of flexion at the knee in sitting and in ascending and descending stairs. It will be noticed that our investigations have extended to the minutiæ of all that pertains to the treatment of joint diseases by continued elastic extension. The plan was so perfect in its details long ago, that one medical reviewer remarked that "it had not yet been improved upon."

We can see no reason for dividing the progress of this disease into first, second, and third stages. We could with as much propriety say that a burning building should be described by the first, second, and third stages of the conflagration. If it is meant to describe the stage of the disease, it does not do it. For instance, it is spoken of as a separate stage when the limb is much shortened by loss of support at the joint. One case may shorten because the head of the femur is destroyed by ulceration. In another case, the head of the femur may be separated by necrosis. In another, shortening may take place from destruction of the upper portion of the acetabulum, with but slight, if any, disease of the head of the femur.

It is evident, therefore, that the stages described by writers give us no definite idea of the actual status of the disease; nor can we appreciate any advantage likely to accrue, in a practical sense, from such subdivisions, for the reason that our treatment is equally applicable to every period of the disease, and should commence with its first symptom, and terminate only, months after the disappearance of all pain and tenderness. It is important to continue our plan of treatment thus long after the subsidence of all uneasiness locally in the joint, in order that the parts which have recently healed may be allowed time to perfect their organization, and become, so to speak, solidified, and competent to sustain the weight of the body in the act of walking.

In cases of ulceration within the joint, the parts, after healing, are in a condition somewhat analogous to recently healed ulcers exteriorly, and the cicatrices covering the impinging surfaces of the cavity of the joint are like the cicatrices of superficial ulcers, as regards their low state of vitality from limited supply of blood-vessels. Cicatrices within the joints are much longer forming than in the skin and cellular tissue, and their powers of resistance being naturally feeble, they are more liable to be affected by the premature application of force and friction, than in the original onset of the disease. When this revival of disease within the joint does take place, it is liable to take on a suppurative form, the new cicatrices breaking down, and being resolved into pus, which accumulates in abscesses within the neighborhood of the joint.

A case under treatment may, perhaps, have exceeded our expectations by the rapidity of the recovery, the limb being at its full length, and the motions of the joint perfect, when, after a few months, the inflammation is rekindled within the joint by excessive exercise of the parts, aided, perhaps, by exposure to cold.

At this time, if the disease is not subdued at once, it is very liable to produce suppuration in a few days. It acts like a traumatic injury to parts imperfectly organized. We see something of a similar kind sometimes happen to the granulations of a superficial wound, from some change effected deleteriously upon the system, resulting in sloughing of the granulations.

Some years ago we stated before the Academy of Medicine of this city, that a patient ought not to die from the advance of the ordinary disease of the hip, knee, or vertebræ. We now go further, and say that they not only ought not to die from these affections, but that they ought to recover without deformity in most cases, and in all, with but slight, if subjected from the first to treatment by *continued elastic extension.*

Why should persons die with ulceration of the joint, if, during the whole progress of the disease, they are placed, through the means of proper apparatus, in a condition in which they are *absolutely free from pain and all constitutional disturbance*, and in which they can eat, drink, sleep, and enjoy life as well as the best, with the slight exception of perfect locomotion? The same is true of Potts's disease and white swelling, those diseases which heretofore have been the dread of both patient and physician, but now need occasion apprehension principally on account of the length of time required for their cure. None but a patient and his attendants, who have gone through the trials of a case of morbus coxarius under the old régime, can appreciate the change for the better which our mode of treatment has effected. Dr. Gurdon Buck, of this city, remarked at a meeting of the Academy of Medicine, "that if there were no other advantage, the relief to the suffering rendered it invaluable." The use of one kind of splint, or another, has nothing to do with our discovery of the great fact that joints were being constantly destroyed, when diseased, by the pressure produced by contraction of muscles, continually holding the diseased surfaces in apposition, and keeping up friction as well as strangulation of the nutrient vessels distributed on the diseased surfaces. The remedy naturally grew out of this discovery, and both were first given to the profession by us. It is unjust for any person because they modify the splint, or some of its details, while at the same time they retain the principle, therefore to claim that the whole discovery belongs to them.

Dr. Lewis A. Sayre, of this city, in a paper read before the American Medical Association, at New Haven, Conn., in May, 1861, claimed all the *principles* as his own, but was compelled, by the indignation of the members, afterwards to introduce into his published paper a description of my splint, with these words: "Dr. Davis was the first to introduce a splint involving these principles," while at the same time there was under the cut of my instrument, as given by him, the following: "Dr. Davis's splint, as manufactured by Otto & Reynders, since 1855"—six years before the reading of his paper.

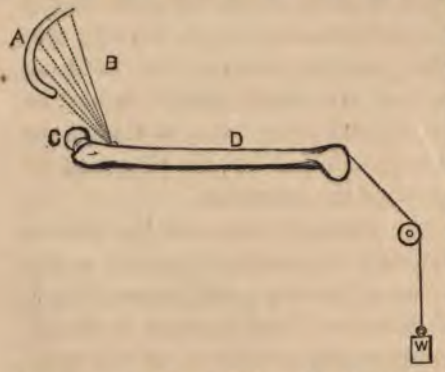
We have said that the treatment by "*continued elastic extension*" is applicable to all stages of disease of joints, from the commencement of inflammation to the destruction of the head of the femur, and the burrowing of matter in every direction about the joint. Even when there is necrosis of the head of the femur, we think it best to trust entirely to unintermitting extension, keeping the limb at its full length, and to wait for the absorption of the necrosed part. We know the majority of surgeons will disagree with us; that they will say, "Open at once and remove the dead bone and allow the parts to heal." Were this all there is of it, it would be very good advice. But let any such surgeon have a child of his own thus situated; then give him the offer of an operation, and the even chance (for such are the statistics) of a fatal termination on the one hand, and on the other the slower process of absorption or disintegration, with a moral certainty of recovery with full length of limb and a serviceable joint, and we think he will not be long in choosing.

It should be remembered that, with our mode of treatment, the child does not suffer pain, and hardly any inconvenience. We have not the alternative, as formerly, of an operation, or death by the slow process of exhaustion from suffering.

TENOTOMY.

If the principle we have discovered is true, and of this there can be no shadow of doubt, that the soft tissues can be elongated by the interstitial deposit of new material when such tissues are kept unremittingly tense, by extension effected mechanically, *then we are never under the necessity of dividing any such tissues to secure the restoration of parts deformed by their contraction.* Hence, as a rule, we should never divide tendons. The doctrine inculcated in one of Dr. Sayre's reports, that in certain cases of morbus coxarius "*continued elastic extension*" is *not* applicable *until* the contracted muscles are divided, *is false* and founded on ignorance of the mechanical application of the principle applicable to the cases he cites to prove his assertion, and only shows the absurdity of a person undertaking to explain something he does not understand.

The author of the doctrine mentioned illustrates his theory and attempts to prove it by citing cases of morbus coxarius where the femur was *flexed upon the pelvis* by contraction of the flexor muscles, and states that if you make extension you increase the pain to an extent unendurable to the patient, which is all very true as far as it goes. But let us see why such is the case. It will be noticed in the accompanying cut, that the large psoas magnus and iliacus internus muscles arise from the pelvis, and are inserted into the small trochanter of the femur; that the principal office of these muscles is to flex the femur upon the pelvis. In the case under consideration, these muscles are contracted, and perhaps actually short-



ened. Now, if you attempt to extend the limb by pulling in the direction of the body, as illustrated in the cut, the head of the femur must be pressed up with a proportionate force against the upper surface of the acetabulum.

This must necessarily give pain, the same as when pressure is applied to the bottom of the foot, or to the knee. The muscles hold the femur at this point as if a fulcrum were placed upon the underside of the bone directly opposite their insertion, but the muscles act at the same time and draw the femur in the direction of its shaft. If, then, pressure applied to the knee or foot, crowding the head of the bone into closer apposition with the socket, will give rise to pain, is it strange that a much greater pressure, affecting the joint in the same way mechanically, should give rise to pain insupportable? This conclusion is verified by the fact that if you make extension in the same case in a line with the shaft of the femur, you not only do not produce pain, but you relieve what pain previously existed, as the consequence of contraction of the psoas and iliacus dragging the head of the femur forcibly against the acetabulum.

When the extension is applied in the direction of the shaft, you do not use the bone as a lever, prying over the fulcrum (contracted muscles), forcing the head up against the acetabulum. It is evident that it is not the elongating of the muscles that gives pain, as the author supposed, but the pressure effected by the direction in which he erroneously applied the extension.

In case the knee is the joint affected, and the limb is permanently flexed, the same mechanical law will apply as pointed out in the case of the hip; and in fact, this is true of all joints—the extension must be made in the direction which will overcome the resistance of the contracted muscles, and serve, at the same time, to separate the diseased surfaces within the joint. We usually apply a weight of three or four pounds in the case of a child five years old.

If the limb is swollen and tender *about the joint*, then we use a lighter weight at first, say one and a half pounds, gradually increasing as the surroundings of the joint become elongated, and the tenderness abates. There is one rule by which we may know that the weight is not sufficient in a given case, viz., if the patient starts and cries out in his sleep. The weight is then not sufficient to effect separation of the diseased surfaces, by wearying the contracted muscles into relaxation.

LOCAL AND CONSTITUTIONAL TREATMENT.

In the inflammatory stage, before ulceration or suppuration has taken place, counter-irritation, if done with the proper agent, will be advantageous. According to our experience, no article equals, in its good effects in synovitis, the hydrg. chlor. cor. It acts as a specific as nearly as any remedy in any disease. In cases of inflammation of the synovial membranes of the knee, for instance, we apply a cloth kept wet with a solution of the above, in the proportion of five or six grains of the cor. sublimate to an ounce of water, and continue it until the peculiar eruption makes its appearance; then discontinue the wash, and bathe the part with tepid water, to free the skin of adherent mercury.

When the inflammation is acute, there will be no danger of salivation from the application, but, if the case is chronic, the same application might affect the mouth. After this acute stage, we apply the mercury in the form of an ointment. Cut a hole of the size of a nickel cent, or a little larger, in a piece of adhesive plaster, and apply it to the place, and fill it with the ointment; then cover it with another piece of the plaster. This secures it from spreading. Keep it on until the epidermis is considerably disorganized. This can be repeated about every third day.

After the first active inflammatory stage is passed, and ulceration or suppuration threatens, or is taking place, then we should devote ourselves to building up and invigorating the general health, by placing the system in the highest state of vitality admissible—by which we most effectually counteract and prevent the destructive tendencies within the joint.

Here allow me to caution my professional brethren against relying upon alcoholic stimulants for this purpose; not but that a certain quantity may increase the appetite and the powers of digestion. But it is a great mistake to suppose that the administration of this kind of stimulus in large quantities will build up the patient's health.

Stimulants in chronic diseases never do good any further than they promote digestion and assimilation of food. Our dependence must be upon nutritious food, efficiently digested and assimilated. In selecting tonics, it is important that we take those that affect primarily the nutritive system. Quinine is considered, by most of the profession, one of our most efficient tonics; yet it is one we seldom use in these cases, because we think its effects upon the nutritive system are secondary. The tincture of the bark has a more direct effect upon the nutritive functions than quinine. Our favorite prescription is a combination of the tinct. cinchona comp. with the tinct. nux vom., three parts of the former to one of the latter. Dose, a teaspoonful four times a day. When there is great prostration and a profuse discharge, we give a pill containing three-fourths of a grain of extr. nux vom., with one-fourth of a grain of chys. nit. argent. This should be given upon an empty stomach, with a swallow of cold water. When there is diarrhœa, some preparation of opium may be combined.

The tinct. nux vom. and the extr. are both tonic to the nervous system, as well as to the nutritive, and therefore possess a double advantage. We never use the alkaloid of the nux vom., because we consider it much inferior to the tincture and extract in its tonic properties. The doses mentioned of the nux vom. are the minimum for an adult. For children, they must be proportionately less. Most physicians have their favorite remedies for certain purposes; we mention ours, but would particularly enforce, as the result of our experience, the importance of treating all forms of ulceration upon the general principle of restoring the system to the highest attainable status of vitality, and this is to be accomplished through the assimilation of sufficient nutritious food.

Meals should be served regularly and punctually. If the patient is in the habit of having his dinner at 1 P. M., which is the proper time, he should not be kept waiting; for the stomach, from habits of punctuality, acquires the habit of secreting the gastric fluid in anticipation, as it were, of the coming meal, and, if it is delayed, the gastric fluid is apt to irritate the stomach and pass into the duodenum. When the meal comes thus behind the usual time, the gastric fluid, designed to perform an important part in the work of digestion, has passed from the stomach, the patient takes the food with a loss of appetite, it is not digested, for the reason mentioned, disturbs the system, injures the appetite for the next meal, and, if a succession of these circumstances occur, the patient will very likely be made sick, very much, perhaps, to the surprise of his attendants and physician.

We have very frequently had patients placed under our charge that were in this condition, and, by enforcing rigidly the rules we have laid down, they would soon be able to eat and assimilate a large amount of food, and this without the aid of medicine.

We debar our patients all candies, sweetmeats, and even fruits, between meals. The habit of giving sick children candies is most pernicious. It will be remembered that patients with this disease are to be put in the highest possible state of vitality, therefore, not even the most trivial thing should be allowed to interfere. If the patient is a child, it is well to give him an associate during meals, and let both be under the care of a cheerful nurse, who devotes her time during the meal to cheerful, amusing conversation. Avoid, if possible, for the patient a dark room—sunlight is one of the requisites of health, beside the mere fact that it renders a room pleasant.

It is not well to inform patients what they are to eat; for the same reason, it is not well to make eating a subject of conversation.

There are, not unfrequently, among patients suffering from chronic disease, "cravings" of the appetite for some particular article of food; and although it might seem improper to gratify this desire, yet it should not be altogether overlooked. This "craving" should not be confounded with a mere wish on the part of the patient to please the palate. The latter is a seeking for a gratification, while the former is a call to supply a want felt by the system. The craving for acids, which some patients experience, is generally an evidence that nature requires them. We have found in these cases that the tr. ferri mur., in comparatively large doses, is beneficial. Dr. Andrews, of Chicago, has given an able paper upon the use of this article, which was read before the American Medical Association for 1861.

If abscesses form and are opened, they should be injected with the chloride of soda. This we have found the best article for the purpose. The effect has been to close the walls of the abscess, down to a small sinus for the escape of matter from the joint. If the extension is constantly applied, and sufficient to separate the diseased surfaces, and the system responds to the invigorating plan of treatment, we may expect that an abscess that is *not* near the surface will be absorbed; if it is so near the surface as to affect the skin, it should be opened before the skin has suffered to such degree that it will slough even after the abscess is opened. We have seen several square inches of surface exposed, from delay in opening an abscess. A compress may be applied after the injection has been evacuated.

We have never seen any unpleasant symptoms follow the simple opening of any abscess, when our patient had been under treatment a short time. We avoid thrusting the finger into the opening, for the purposes, as some surgeons do, of exploring. Surgeons seem to forget that the finger acts injuriously, as would any other foreign body, and that the flesh of a person reduced by hip disease is in that low state of vitality, that it is readily induced to take on a low grade of inflammation, and thus yield what little vitality it has.

We speak from observation, and in every case where the abscess was simply opened, injected with water, using but slight pressure to remove the matter or the water, and then injecting the chloride of soda, the abscess has closed up without any constitutional disturbance. On the contrary, in several cases where efforts were made to ascertain the condition of the joint by thrusting in the finger, erysipelatous inflammation in some instances, and severe constitutional disturbance in all, has been the result.

We give a single case of morbus coxarius, to illustrate the beneficial effect of our mode of treating the disease:

It will be understood that this case had been treated in the usual way for three years, and when it came under our care the disease had nearly destroyed the patient; she could have held out only a few weeks longer. It was remarked by a prominent surgeon, after examining a severe case of the disease which we had under treatment, that such cases illustrated the advantages of our treatment far better than those that were slight, for by the old plan such cases all died.

Hattie R., age seventeen; strumous constitution; had lost all her teeth by decay; had morbus coxarius of the right hip; came under our care July, 1860.

Three years previous, the disease manifested itself by a slight lameness, some pain, with a feeling of stiffness about the joint. She would at times so far improve as to appear to be recovering; then there would be an exacerbation of all the symptoms. The disease followed this paroxysmal course, until she came under our care, and was subjected to treatment by extension.

Each exacerbation left the patient worse than before, and she became very much emaciated, with countenance haggard, anxious, and expressive of great and continual suffering; appetite was very poor; pulse feeble and rapid, with hectic fever and night-sweats.

She had taken opiates freely, yet obtained but little rest. Her general condition was very discouraging.

She lay upon her back with both limbs drawn up, and supported in that position by bolsters, the left limb being nearly as painful, from confinement, as the other. The right limb, about the hip-joint, was swollen very large; superficial veins prominent; fluctuation distinct, though the matter was deep-seated. Her position had not been changed for some weeks, any such attempt causing an agony of pain. Her right limb was apparently an inch shorter than the other, but accurate measurement could not be obtained, in consequence of their flexed position.

Applied *elastic extension*, without changing the angle of the limb at the pelvis, an important consideration, for reasons elsewhere specified.

There was immediate relief to the pain as soon as the extension commenced. So perfect was it that she slept all the ensuing night; the countenance lost its expression of anguish.

The extension being continued without intermission, the flexion was soon overcome; the swelling diminished very much, the tenderness abated, and the joint soon allowed of free motion.

The appetite improved, and a steady increase of flesh and strength ensued.

Counter-irritation with the solution of corrosive sublimate was used about the joint, and evidently promoted absorption to a considerable extent, or at least in conjunction with the continued elastic extension, arresting the further progress of the abscess within the joint.

Our splint was used during the day, after the tenderness was removed and the limb straight. It was kept on as long as it was comfortable, and then exchanged for the pulley and weight. We will mention here that about four pounds weight was applied to the limb at first, and increased in a few hours to eight, and eventually, up to twelve pounds.

After several months, the abscess opened in front nearly opposite the joint, but very little pus escaped.

The sinus remained open, discharging perhaps a small teaspoonful during the twenty-four hours.

After several months, a fragment of bone presented itself at the opening, and was removed by the patient; it was a scale of bone as large as one's thumb nail.

The sinus remained open a full year, and she frequently in the mean time detected gritty particles in the discharge. The splint has been worn constantly for four years, and there has been a steady improvement up to the present time, July 5th, 1865.

Her condition now is as follows:

There is no perceptible difference in the size of the limbs, and the whole system is well nourished, she having been in uninterrupted good health and is remarkably fleshy.

The affected limb is from one-third to one-half an inch shorter than the other, with free flexion and extension, but not a normal degree of freedom in adduction and abduction, which is probably due, to a great extent, to want of exercise of the limb in these directions.

She can support her entire weight upon the limb, and *can* walk without a cane, but, as a matter of prudence, generally uses one, but does not always support herself upon it in walking. There is every probability that she will recover so as to walk without any lameness. The head of the femur was, without doubt, destroyed, leaving only the neck to form the articulation with the acetabulum.

When it is remembered how unpromising was the condition of this patient when placed under our care, the good which may be accomplished by perseverance in our mode of treatment is most strikingly illustrated.

The objection may be raised, that so long a time was consumed in the treatment; but this will be found more apparent than real, when we take into consideration the fact, that after perhaps two months, or ten weeks, she was able to sew and do many other light duties compatible with sedentary life; she being, during the long lapse of time, free from pain and in the enjoyment of excellent health. After the first year she required no surgical attendance, and has been sick only once for a short time, from some other unimportant cause.

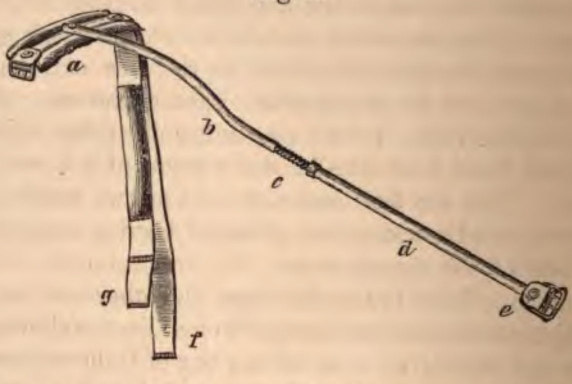
As a reward for her faithfulness and perseverance, she has a limb which is almost perfect in its functions, whereas, by the old method of treatment, she would have been in imminent danger of losing her life, and, if she had recovered, the limb would have been from two to five inches shorter than its fellow, and probably fixed at the joint at a greater or less angle with the body. If she had been under the HEROIC treatment by exsection, and had *escaped* with her life, there would have been no comparison in the usefulness of the limb; it is the favorable result of our treatment in these bad cases, that decides us to prefer this mode to that of exsection.

Description of apparatus.—The apparatus, by means of which my treatment embodying the principles advocated in this paper can be carried into effect, is simple and easily explained.

It must be borne in mind, that I have already said that the essential parts of the apparatus are, means of exerting an elastic, continually extending force on one side, and a resisting counter-extending one on the other.

The modifications it undergoes to adapt it to the various regions of the body, every physician can readily understand. I shall describe particularly the splint as applicable to the hip-joint. Reference to the wood-cut (Figure 1) annexed will further aid the reader.

Fig. 1.



An elastic perineal band (*g* in the figure) really constitutes the extending force; adhesive plaster strapping around the limb, concentring at a point a little above the external malleolus, the counter-extending power; while a metallic splint (*b*, *c*, *d*, *e*) is stretched between these, and enables them to fulfil the indications proposed.

The splint is composed of four parts, viz., an upper or pelvic portion (*a* in the figure), a thigh portion (*b*), a leg portion (*d*), and an ankle portion (*e*).

The thigh portion consists of a metallic tube curved above (*b*), to correspond to the convexity of the thigh, and ending below in a short, straight piece, to which a long iron double-threaded screw (*c*), also hollow, is firmly secured. The leg portion is a straight metallic tube (*d*), closely investing the screw (*c*), and projecting but little beyond. It is attached to the ankle portion (*e*) in such a way that, in revolving it, in order to lengthen or shorten the instrument only the screw investment with its nut is turned, while the ankle portion remains unmoved. This ankle portion (*e*) consists of a triangular-shaped flat piece of metal, covered by a buckle (as seen in the figure).

The pelvis portion (*a*) is more complicated than the others. A slightly curved strip of steel, half an inch or more wide, from four to six inches long (both the length and width varying according to the size of the whole splint), is riveted through its centre to the free extremity of the thigh portion, and admits of rotary motion. At one end of this strip of steel a buckle, and at the other the perineal band is attached, and the whole of it is well cushioned. The perineal band is formed of two bands (*f* and *g*), of a length, width, and strength varying according to the size of the apparatus and the circumstances of its application. One (*f*) is longer than the other and inelastic, being made entirely of strong cotton or linen webbing; the other (*g*) is, as it were, an oblong bag of India-rubber webbing (formed by sewing two strips of rubber webbing together) filled with saw-dust, obtained by sawing across the fibre of pine wood (not lengthwise), tipped at each end with some of the inelastic webbing (such as *f* is made of). While the inside elastic band keeps up the extension required, the inelastic sustains any weight that exceeds the extending force as then applied to the patient. It is this arrangement that enables the weight of the body to be borne without harm, as in walking, and that prevents injury from excessive weight or pressure upon the articulating surfaces in cases of accident. Thus, for instance, the head of the femur would, in walking, be violently thrust upward, as the elastic band would yield to an increased weight, were there no inelastic, unyielding band to prevent it; yet, it is obvious that this inelastic band does not interfere with the predetermined amount of tension to be exerted by the elastic one. (This amount of extension is determined and regulated as follows: Buckle the two bands unequally, *i. e.*, let the loop formed by the outside band be longer than that of the inside, and attach a weight to the latter. The number of pounds requisite to stretch the one loop to the exact length of the other represents the amount of extending force the instrument will exert, when exactly thus buckled, when applied upon the limb.

I will add here, that the amount of extending force should be ascertained in every instance before fastening the splint upon the patient; this amount is not to be varied by altering, by means of the screw, the length of the instrument, but by adjusting the two bands.)

I have found the rubber webbing, with napkin protection to the skin, to be much superior to the rubber tubing. The tubing is seldom of the right elasticity, and is more liable to heat and excoriate the skin than the webbing, for the reason that it does not absorb the secretions, nor allow the air to come in contact with the skin.

Mode of application.—Cut from a piece of adhesive plaster, spread on twilled goods and kept until the oil entering into its composition has become oxidized, two strips from 1¼ to 1½ inches wide, of the length of the limb from the pubis to the malleolus, and two strips a little narrower in proportion to the others, but one and a half times as long. Fold about an inch and a half of one extremity of each of the first cut strips upon itself, the adherent sides to each other, and apply one on the outside and one on the inside of the limb, commencing with the folded end about two inches above the outer and inner malleoli, and extending it up in a straight line.

The other two strips are applied spirally around the limb as follows: commence on the lower or folded extremity of the straight strip above the outer malleolus, and wind around in front and back, so that the two spiral strips meet in front, a little distance above the patella (as very well depicted in the wood-cut, Fig. 6).

Fig. 6.

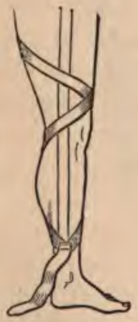
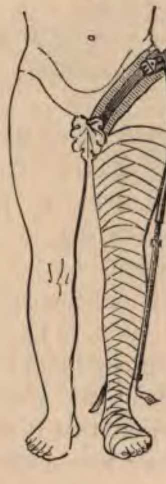


Fig. 7.



Next, sew a piece of firm, *inelastic* (linen or cotton) webbing, about $1\frac{1}{4}$ inches wide and from six to eight inches long, to the lower extremity of each straight strip, taking particular care to include in the attachment the ends of both spiral strips above the external malleolus. The limb is then closely and firmly enveloped with a common roller bandage, from the foot upward (as shown in Fig. 7), the pieces of webbing only being left outside free. Now buckle the ankle portion of the splint upon the external face of the limb by means of the webbing; protect the skin of the groin and parts to be covered by the perineal band by a piece of old, soft napkin or table linen, several times folded and secured by a few stitches; and having previously adjusted the two bands composing the

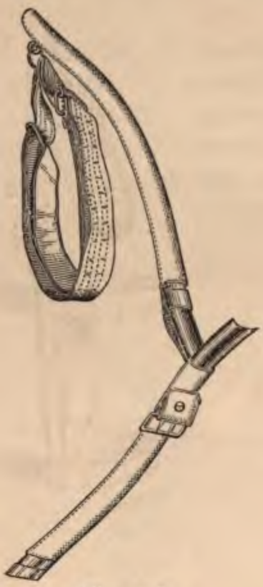


Fig. 1.*

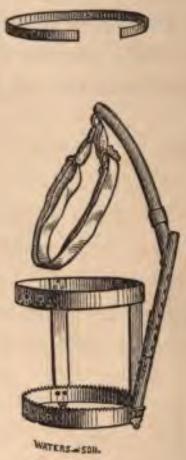


Fig. 2.

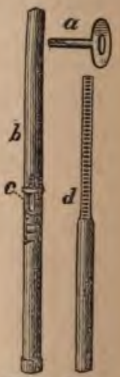


Fig. 3.

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* This form of Splint I first used in 1855.

perineal band, as mentioned, fasten the latter around the thigh, always taking care to have the buckle on the pelvic portion of the splint in front; the screw of the splint regulates its length, so that the required amount of extension can be secured. When all is correctly arranged, and proper extension made, the upper extremity of the splint should fall just below the crest of the ilium.

We give cuts of several different splints that we have used, though they are but a small portion of the whole number we have invented.

"No. 1, an elbow-joint splint. The joint admits of the splint's being shortened during its application. When applied, it is secured straight by a slide. The amount of extension is regulated by the band and buckle at the bottom, or the buckles and cat-gut at the top.

"No. 2, the same principle applied to the femur.

"No. 3, the length is varied by a key and ratchet; the key performing the office of a cog-wheel.

"No. 4, the key and ratchet, applied to the thigh portion of No. 2.

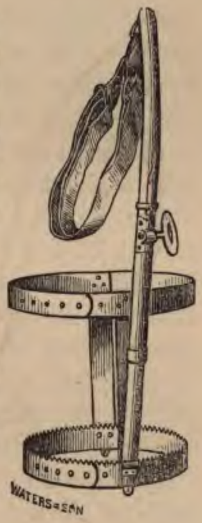


Fig. 4.

ULCERATION OF KNEE AND OTHER JOINTS.

We do not consider it necessary to devote much space to the consideration of the pathology and treatment of each joint specifically, as we have given the pathology and the principles of treatment under the head of synovitis and morbus coxarius, or tuberculosis of the hip-joint.

The surgeon will understand that in all diseases in and about joints, if such disease by any cause interferes or prevents motion, whether it be because the pain consequent upon motion prevents it, or from any other reason, the joint is retained in an unchanged position, *continued elastic extension* should be applied to overcome the contractile force of the muscles, by which the joint is confined. This contractile force of the muscles finds its resistance in those portions of the articulating surfaces of the joints that are in contact, varying according to the position of the limb. This uninterrupted pressure strangulates the vessels, and thus prevents the nutrition of the parts pressed upon. It would appear unnecessary to state here that death follows to parts whose nourishment is cut off, yet these facts as affecting joints were never recognized by the profession until the publication of our paper upon the subject, read before the New York Academy of Medicine, in 1860.

In accomplishing extension in disease of the knee-joint, there is one point to which we would call the attention of the surgeon. In disease of the hip-joint, we make extension by the femur or by the femur and tibia both. This mode of application will not be sufficient in disease of the knee-joint, that is, it will not be sufficient to attach the adhesive plasters over the surface of the tibia and fibula and then make extension, thinking thereby that we are doing all that is necessary to separate the several parts involved in that joint. This extension will perhaps separate the head of the tibia from the condyles of the femur, *but it will not relieve* the pressure of the patella upon the femur. This must be done in the way we have described under the head of fracture of the patella. By combining this arrangement with the extension by the tibia and fibula, we relieve all the parts of the knee-joint.

In disease of the ankle-joint for which extension is requred, it will be quite impossible to do it by means of the foot, as the parts would suffer from the pressure. Extension can be readily accomplished, however, by applying the adhesive plasters over the bellies of the muscles whose contractions we wish to counteract, in the manner described under the head of fractures of patella and other bones The importance of the discovery that the action of muscles can be effectually overcome by applying the plasters over their bellies is well illustrated in the treatment of disease of the ankle-joint, for we should be quite debarred from accomplishing extension in the case, were it not for this plan.

APPARATUS FOR KNEE-JOINT.

Figures Nos. 5 and 6 represent an apparatus for effecting extension of the knee-joint. It has two steel bands around the thigh, one near the pelvis, the other near the knee; these are secured together by strips of steel. This arrangement renders each a support for the other. Upon these last-mentioned steels others are fastened that extend down and terminate in a joint against that of the knee. The other arm of the joint extends down, and is connected with a frame similar to the one described to surround the thigh, but is not, like the other arm, fastened to the tibial portion; instead, it has two slots, in which are two rivets, secured to the tibial portion;

these rivets hold the arms to the tibial frame, yet allow them to traverse the length of the slot. To the bottom of these arms are fastened a piece of heavy rubber webbing, heavy and strong in proportion to the size of the instrument. It will be noticed that this rubber is attached to the arm, which is firmly fastened to the femoral frame,

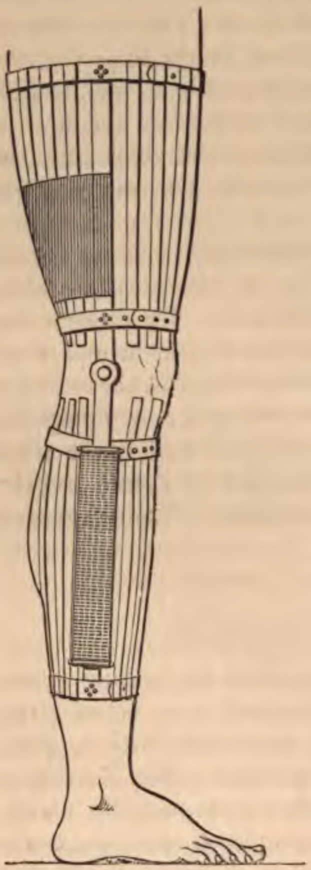


FIG. 5.

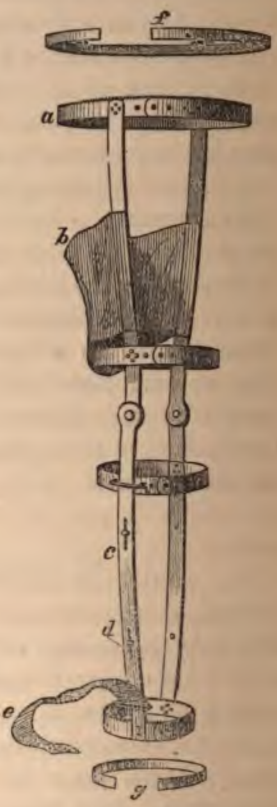


FIG. 6.

while the other end is connected with a loop of wire on the tibial frame. By this arrangement, the rubber forces the femoral frame up, while at the same time the tibial frame is drawn down; therefore, when these two frames are secured by adhesive straps, one to the surface of the femur, the other to that of the tibia, the rubber acts to separate the knee-joint. This it does when the limb is straight, but when it is flexed from a straight line, the rubber then forces the femoral part of the instrument in the direction of the tibia.

To keep up the extension after flexion begins, there is placed under the ham a firm piece of leather, secured to the femoral frame, marked *b* in Fig. 6. The contraction of the rubber expends itself upon this leather band, lifting, as it were, the condyles of the femur from the head of the tibia. Thus extension is effected upon the knee-joint from a straight position of the limb to a right angle. This apparatus will answer in mild cases of disease of the knee-joint; in most, however, we prefer the more powerful action of the hip-splint. This instrument performs an admirable part in retaining deformed limbs in their position.

We would here inform our professional brethren that we long since relinquished our patent for making splints from metallic tubing, although we had years before given to the profession the plan of treatment, with a great variety of splints, for accomplishing it. We devised a mode of making them by machinery from metallic tubing, that the same part in each splint would be alike, and could be replaced by a new one when injured; this being attended with expense to us, and furnishing a more perfect instrument for a less price, and, more than all, as the instrument was usually paid for by the patient, we could see no violation either of the letter or spirit of our code of ethics. Some members of the profession, however, felt aggrieved, and we do not wish to "offend" any brother. We hope, however, our brethren will soon consider it as derogatory to a man's standing in the profession to rob a brother of his discoveries, as it is to patent a splint after having given to the profession the treatment in full, together with a large variety of apparatus for accomplishing it. We trust also that the time is not far distant when intellectual efforts to preserve the human form intact, by attention to its mechanism and the construction of apparatus for its preservation, will be considered as humane and as honorable, and will be as highly appreciated, as is the devising of some new mode of mutilating it at the present time. The longer we pursue our investigations in the department to which we have devoted so many years, the more convinced we become that there are in it *great truths* yet to be discovered—truths that will revolutionize our treatment of many surgical as well as other diseases.

We, as a profession, have never studied, as we ought, man as a machine; neither have we investigated the influence that mechanical causes exert in health and disease upon its structure. The absence in some, and the neglect to cultivate them in others, of those faculties which are so important and necessary to constitute an expert in this field of investigation, is a great hindrance to the ready comprehension and acceptance of any truths discovered by such researches.

If there is no necessity for specialists in any other department, there certainly is in that of "conservative or mechanical surgery," as distinguished from operative surgery. There are so few in any sphere, much less among professional men, who possess large mechanical ingenuity, that all progress in this direction must necessarily be limited to those endowed by nature with this capacity. Again, it is absolutely impossible for a man destitute of mechanical ingenuity to accomplish any thing new by en deavoring to invent mechanical appliances, or to discover mechanical causes operating in health or disease. When the profession are willing to aid every man in investigating in that direction for which he feels himself best qualified, then we shall have every member using his faculties to the best advantage, always with the understanding that he first goes over the whole field of our science.

TUBERCULOSIS OF THE SPINE, OR POTT'S DISEASE.

Tuberculosis of the spine is a very different affection from lateral curvature.

The former is produced by caries of the vertebræ. The distortion is not only antero-posterior, but angular, and is essentially dependent upon organic disease of the osseous tissue; whereas, in the lateral distortion, the curvature is induced by irregular muscular contraction acting upon weakened bones, fibro-cartilages, and ligaments, dragging them out of their natural position, and inducing more or less deformity.

Toward the latter part of the last century, Mr. Pott gave a very graphic account of this disease, and it has since been generally known by his name.

His observations and dissections so clearly pointed out its etiology, pathology, and the more general indications for treatment, that little, if anything, of real importance has been added since then to our knowledge upon this subject, except the treatment by mechanical means.

From the destructive character of this affection, it has always engaged the serious consideration of surgeons; and it has only been since the masterly investigations by Mr. Pott that its true nature has been understood.

The vertebral bodies being composed, to a great extent, of areolar tissue, invested by a thin layer of compact substance, are liable to tubercular deposits, similar to such as are frequently found in the tarsal and carpal bones and in the articular extremities of the long bones.

The disease is much more common in the dorsal region than in either the cervical or lumbar, but may occur in any portion of the spine.

The third and fourth pieces of the dorsal vertebræ are the ones most liable to this disease, but it is difficult to assign any satisfactory reason why the tuberculous affection should manifest such decided preference; such, however, is the fact, and it is one of great importance both in a diagnostic and practical sense.

This disease is much more common in children from the age of two to fifteen years; and cases are on record in which the patients were younger, as well as much older—in some as late in life as the thirty-fifth year. Such cases are, however, rare, and are regarded as exceptions to the general rule that this is a disease of early childhood.

The disease occurs in both sexes without any special partiality, and in all classes of society, although more common in the lower walks of life, among the poorly fed and insufficiently nourished occupants of the crowded, unhealthy localities of large cities, and may always be found to depend upon a strumous condition of the system.

It is a local manifestation of a constitutional taint, and, like tubercular disease of the lungs, is dependent upon deterioration of the blood and consequent dyscrasia.

This scrofulous diathesis constitutes the predisposing principle upon which the disease of the spine depends, and is the concomitant status of the system which precedes the appearance of the local affection of the vertebræ.

Exposures to changes of climate, external injury, and such attendant circumstances as exercise a depressing influence, may excite the disease into local development; but no such results could follow if no predisposition to the affection were dormant in the system previous to the action of the exciting causes.

Deposition of the tubercular matter, which is the immediate cause of Pott's Disease, occurs in the areolar structure of the bodies of the vertebræ, in the form of rounded, distinct masses, from the size of a millet-seed to that of a pea, some of which may be encysted—or it may occur as an infiltration.

This deposition of tubercular matter may also occasionally occur upon the surface of these bones, in the substance of the periosteum or upon its surface, and upon the intervertebral cartilages.

The period of time which elapses between the deposition and its becoming softened and disintegrated is uncertain; but the substance is doubtless governed by the same laws which pertain to it when deposited in other portions of the body. The process of disintegration, however, when it has once set in, generally proceeds very rapidly, and often produces irremediable havoc in the course of a few weeks, almost destroying the affected structures, and causing great deformity.

In consequence of the stealthy manner in which this disease usually comes on, it often makes very serious inroads, both locally and constitutionally, before its true character is even suspected.

Sometimes the disease of the spine is limited to a single piece, but generally it attacks two or three, the spongy substance of which, together with the intervening fibrocartilages, and the contiguous periosteum, is eventually completely destroyed.

If post-mortem examination be made of the parts affected with the disease at this stage of the progress of the malady, a gap corresponding in size to the number of the vertebræ implicated will be found to exist in front of the spine, more or less occupied with portions of tuberculous matter, disintegrated bone, and fragments of thickened periosteum and fibro-cartilage. The roots of the spinal nerves, as well as the spinal cord, will be found more or less denuded, and the remaining portion of the diseased vertebræ to be thrust backward in such manner as to cause great projection of the spinous processes, and very marked antero-posterior curvature.

The ribs corresponding with the affected vertebræ are often implicated in the destructive process, and the matter is sometimes extensively diffused over their internal surface.

The earlier symptoms are such as usher in a gradually declining state of the general health.

The patient looks pale and feeble; his bowels become irregular and his appetite variable; the strength easily gives way under exercise, the gait becomes tottering and vacillating, and the lower extremities become affected with a sense of numbness and occasional spasmodic twitchings; pain and discomfort is felt along the spine, especially over the seat of the affected vertebræ; the urine is scanty and alkaline, the sleep is restless and disturbed, and there is occasionally considerable fever at night, which may be followed by perspiration toward morning. The symptoms, in time, assume a more decided character. The pain in the back increases, and pressure upon the part generally causes a peculiar sickening sensation, and a feeling of constriction in the chest is experienced, as if the thorax were bound round by a tight band; greater difficulty in walking is experienced, and the general debility becomes more and more marked; the numbness in the lower extremities, which has also steadily increased, is now generally conjoined with a disagreeable sensation of prickling, resulting from the pressure upon the spinal cord.

The degree of paralysis accompanying the disease varies, in some cases being extremely slight, and in others so great as to completely interrupt the power of locomotion. As a general thing, motion is impaired before sensation.

The distortion of the spine is angular backward, varying in extent according to the number of vertebræ implicated and the length of time during which the disease has existed.

The longer the period of its existence, the more characteristic will be the deformity.

When there is serious involvement of the ribs, the angular deformity is often associated with a kind of knob-like enlargement around the seat of the disease.

The spine is bent backward, in the more aggravated cases, many inches beyond its natural position; the chest is much elongated in the antero-posterior direction; the sternum is pushed out in front, and the head is sunk down between the shoulders, giving that peculiar hump-back appearance so strikingly characteristic of the disease in its confirmed stages.

There are, however, other causes than the tubercular deposits which give rise to destruction or caries of the bodies of the spinal column, which are of a traumatic character, or the result of local injury to the vertebræ, or resulting from rachitis, periostitis of the spine, and partial fractures. Syphilis also has been traced as a cause of this deformity.

Where the exciting cause of this affection is mechanical injury to the spine, it is found to occur more frequently in boys than in girls, and is not confined to any social class, as is apt to be the case when arising from constitutional causes.

The deformity arising from injury to the spine is more liable to occur at one part of the spine than at another—thus, is rarest in the cervical, less rare at the lumbar—oftener at the thoracic, and most frequent at the thoracico-lumbar region of the spinal column, which latter portion of the spine is the place at which fractures and injuries are most liable to take effect.

This deformity is of very slow growth, when not arising from displacement occasioned by fracture.

When occasioned by local injury, it will be found to have occurred in a child previously well and rugged, and accustomed to the careless and often rough exercise of childhood, during which he has sustained injury to the spine perhaps by a fall upon the back, not sufficiently severe, however, at the time to give rise to much complaint, and, when the complaint is at last made, the lapse of time has caused to be forgotten the connection between the fall and its effects.

The patient's general health eventually fails, if the spine has become affected, and evidences of general debility manifest themselves. The child becomes pale, sallow, and anæmic, and indifferent to exercise. His appetite is uncertain, bowels irregular, urine charged with excess of urates, and sleep uneasy and disturbed.

He prefers quietude, and is unable to join in the sports of his companions for any great length of time, and if he does is obliged soon to desist and rest, from shortness of breath and palpitation of the heart.

When he is not lying down, he seeks at all times to support the back by placing his arms on a table or chair, or by resting the head upon the arms placed upon the knees.

Or he will throw himself across his mother's lap, or lean over a chair. In stooping down to pick something from the floor, he bends both the hip and knee-joints, and gradually lowers his body in the upright position until his hands come near enough to grasp the object, when he as gradually and carefully rises to the erect posture, supporting the body during the effort by placing one hand upon the knee.

The pain attending this deformity is peculiar, and is felt around and in front of the body, and not so much at the immediate seat of the disease, unless excited by percussion, or sudden twist, or jarring.

When the disease is situated in the thoracico-lumbar portion of the spine, the patient is apt to complain of pain in the stomach, and occasionally of some difficulty in the discharge of urine.

At the thoracic portion of the spine, the disease will be apt to give rise to difficulty in respiration.

When situated in the cervical portion of the spine, the disease causes some difficulty in deglutition.

Stiffness of the spine is noticeable in those postures and movements, in which the spine is concerned. All the movements of the patient are careful, in order to obviate the slightest disturbance of the spine.

The exact seat of the pain, and its irradiation through the cervical, intercostal, or lumbar nerves, may be localized by placing the patient in the prone position, and exploring the spine with a hot sponge, by using percussion, and by lateral movements of the body.

The prominence of one or more of the spinal processes may be ascertained by placing the patient in a prone position upon a firm mattress, and observing the projections and incurvations.

There will be no difficulty in coming to a correct diagnosis, if the deformity has existed for some time, during which the patient has been allowed to walk. There will be more or less posterior curvature, with a corresponding anterior deviation or compensating curve. Over the immediate site of the curvature, the integuments will be apt to be found attenuated, allowing marked prominence to the spinous and oblique processes.

Among the consecutive effects of the progress of this deformity, may be noticed malformation of the thorax, in which the ribs and sternum are elevated, and its width is considerably increased, while its length is correspondingly diminished.

Attenuation of the body, generally, is another consecutive effect, and probably depends upon interruption of the functions of the great sympathetic nerve.

Paralysis of the lower extremities, also consequent upon this distortion, has been variously ascribed to mechanical compression of the spinal nerves or of the spinal cord; to the opening of an abscess into the spinal canal, allowing sequestra to find their way into the opening, and acting as mechanical impediments; also to hyperæmia, irritation, and inflammation of the membranes and of the cord itself.

The paralysis usually affects the nerves of motion, but less frequently those of sensation.

When the lumbar portion of the spine is affected, contractions of the flexor muscles of the thigh may occur, and should not be mistaken for disease of the hip-joint.

Manipulation of that joint will discover it free from pain upon pressure or motion, and with no impediment to adduction and abduction.

The formation of consecutive abscesses usually results when the disease of the vertebræ or surrounding structures has advanced to ulceration, and has received the term of cold abscesses, on account of the attending symptoms being of a low character, attended by little pain or discoloration of the integuments.

These abscesses usually appear at some distance from the seat of disease, through the influence of gravitation, and, when collected under a continuous fascia, will diffuse themselves until circumscribed by the limits of the fascia concerned. Both the circumscribed and diffused forms of abscess may occur in the same patient, and they may occasionally disappear by gradual fatty degeneration, and absorption of their contents.

Where the disease of the cervical vertebræ has proceeded to ulceration, the pus descends below the longi colli muscles and their aponeuroses, elevating them from the spine, and encroaching upon the posterior wall of the pharynx, causing post-pharyngeal abscess.

The location of the abscess may, however, vary, sometimes descending outside of the sterno-cleido mastoid muscle and above the clavicle; or, if the matter arises at the lower cervical portion of the spine, it may collect in the axilla, by descending along the course of the brachial flexus.

When the matter arises from disease of the dorsal vertebræ, it usually collects in the posterior mediastinum, and follows the course of the aorta through the diaphragm, thence down the track of the iliac arteries, making its appearance at the femoral fossa; or it may get under the fascia of the psoas muscle, and collect in the neighborhood of the trochanter minor, and it has been known to descend into the pelvic cavity and to perforate the rectum.

When the abscess is the result of disease of the lumbar vertebræ, the pus may follow the course of the aorta and iliac artery, collecting at the femoral ring; or it may follow the direction of the psoas muscle, appearing near the small trochanter; or the matter may enter the hip-joint, when it penetrates the bursa of the ilio-psoas muscle, or the ilio-pectineal.

Sometimes the matter takes a more direct route, and is discharged in different directions upon the back, forming dorsal and lumbar abscesses.

Not unfrequently diseases apparently remote have their origin in the spinal cord or the nerves proceeding therefrom, and it is not uncommon to make applications to the part or direct medication to the organ which seems particularly affected, instead of to the spine, which is the actual seat of the disturbance.

Various affections of the bowels, and all the abdominal viscera, palpitations of the heart, dyspepsia, flatulence, &c., may frequently, upon close examination, be found to originate in some derangement of the spinal column, and the same will apply to anomalous complaints of young persons, particularly where the upper and lower extremities are affected.

Pain in the back of the head, confined principally to the scalp, is a common affection, consequent upon spinal irritation, and yet it is not common to refer it to this cause.

Derangement in the nervous influence may result from even a slight curvature of the spine, and an inclination of the bony column to one side, although it may be so slight as hardly to be perceptible, has its influence upon the great spinal nerve, the ganglia, and the nervous filaments which proceed from them.

Permanent deviation of the spinal column from an erect position cannot occur without danger of disturbing the functions of some remote organ or part, which is supplied with nerves from the spinal cord.

Dr. John B. Brown published in the Boston *Medical and Surgical Journal*, 1839, the following cases:

"I was called to a patient, not long since, a lad about fifteen years old, who had a variety of complaints not readily accounted for. He had been attended by an eminent physician, a gentleman for whom I have the highest respect. His complaints were a painful affection of the eyes, palpitations of the heart, indigestion, a painful affection of the scalp, and a torpid state of the alimentary canal.

"I immediately examined the spine, and passed my fingers up and down its whole length. I found two portions of it tender, namely, about the middle of the dorsal, and the middle of the lumbar vertebræ.

"When I pressed upon the transverse process of the middle lumbar vertebræ, he invariably complained of pain in the abdomen. These circumstances convinced me that all his complaints proceeded from spinal irritation, and I stated my conviction to the physician who had attended him. He could not be persuaded that all this chain of symptoms could proceed from this source. In the course of two or three weeks, three of the lumbar vertebræ began to project. They were evidently enlarged, probably from inflammation and swelling of the intervertebral substance. The attending physician was then convinced that all the complaints of this lad were caused by a disease of the spinal column and the nerves that proceeded from it, affecting remote parts and organs."

In connection with this subject, and to show how diseases in remote parts of the body may have their origin in, and be connected with, diseases of the spine and its nerves, I will relate a case which a medical friend stated to me came under his observation.

"The patient was a boy, who complained of extreme pain in the three small toes of his left foot.

"The pain was excruciating; still no disease in them was apparent. There was no swelling, no redness, no symptom of inflammation. The appearance of the toes was natural. Leeches, blisters, and poultices were applied, but to no effect.

"The pain was so excruciating, that the boy could get no sleep for several nights in succession. Very large quantities of laudanum were given, but without producing sleep, which could not be obtained.

"Consultations were held, and it was agreed upon all sides, that the case was a singular one, and not easily to be accounted for. The attending physician, as he was sitting by his patient one day, passed his fingers, rather accidentally, down his back until they came to the sacrum, when the boy immediately screeched out, 'Let my toes alone.' He then passed his whole hand upon the sacrum, and the boy cried out again, 'Let my blister alone,' meaning the blister on his foot.

"The fact is, that when the doctor pressed with his fingers, the sensation was more marked and definite; but when he pressed with his whole hand, the sensation was as if the whole blistered surface of his foot was rudely touched.

"Applications were immediately made to the sacrum and lower part of the spine, and the boy was relieved."

Mollities ossium and rachitis may produce shortening of the spinal column without any material deviation from the perpendicular. The two diseases have been confounded with each other, but rickets, it should be remembered, is a disease of childhood alone, and is accompanied by other marks of the disease, as curvature of the legs, while mollities ossium occurs in mature age, and is referable to some pre-existing constitutional disease, as syphilis, cancer, &c.

This abnormal state is called *shortening of the spine.* As it causes an eversion of the lower ribs, it gives rise to an appearance common also to angular projection, which is called chicken-breasted. When the lumbar vertebræ are the seat of the disease, the chest is liable to settle down toward the pelvis, so as sometimes to bring the ribs in contact with the crest of the ilium. The paralysis is not always proportionate to the amount of pressure on the spinal marrow, but, as it increases, the sphincters lose their power.

This disease is necessarily of a grave character under any circumstances, on account of the serious inroads it makes upon the parts and the general system, and the prospects of an ultimate cure are very limited, where it occurs, as it generally does, in children of a broken-down constitution, inadequately fed, and whose bodies are saturated with the strumous diathesis. Such patients usually perish from hectic irritation, while those who do recover are permanently dwarfed and hump-backed.

Restoration is much more likely to occur in a better class of patients; and if the case be properly managed, excellent cures, with little or no deformity, may be effected, even when considerable structural change has occurred.

The prognosis is generally less favorable when the disease is situated in the cervical region, than when it affects the dorsal or lumbar, although occasionally remarkable recoveries are witnessed.

When the disease affects the cervical vertebræ, it not unfrequently proves fatal, death occurring in one of several ways—thus, an abscess may form, and, by bursting into the larynx, instantly suffocate the patient, or, by bursting into the spinal canal, may destroy life by inducing compression of the spinal cord.

In consequence of ulceration of the transverse ligament, dislocation of the odontoid process may occur, necessarily proving fatal suddenly.

The accidental giving way of some of the diseased portion of the vertebræ would none the less prove fatal by the injury inflicted upon the spinal cord.

When a cure is about to be effected in this disease, nature sets up a process of repair, consisting at first of an effusion of plastic matter, which may begin at one part while the diseased action is still progressing in another. This plasma is gradually organized into bony substance, and supplies the place of the destroyed vertebræ, the breach being filled up in accordance with the fœtal process of ossification.

This new ossific matter is extended across the chasm in the spinal column, and does not encroach upon the spinal marrow, and becomes whiter and more solid than the original bones—uniting into one solid mass, by anchylosis, the contiguous bodies of the vertebræ, the remnants of the arches, the spinous processes, and the heads of the adjoining ribs, or so far as the disease may have extended.

We have given a synopsis of the opinions entertained by some of the members of the profession, as published—preferring to give our views separately and in the order observed in the foregoing pages of this chapter.

Why most frequent in the dorsal vertebræ.—We think a good reason lies in the fact that most of the antero-posterior motion of the trunk is acquired through the dorsal portion of the spinal column, and the pressure falls upon a smaller space than in the lumbar. Therefore the anterior edges of the dorsal intervertebral cartilages are much more exposed to be injured by severe compression than any other portion of the spine.

This is apparent when we reflect that as this portion admits of freer motion than any other, and can be brought into a comparatively small arc of a circle, the whole pressure must come upon the anterior edge of the body of the vertebræ and the intervertebral cartilage, and that this may amount to a traumatic injury, and if such injury gives rise to inflammation, it will follow the constitutional tendencies, or the peculiar diathesis of the individual.

We have not unfrequently seen the disease arise in this locality after the child has suffered from hooping-cough. In such cases, the vitality of the system being materially reduced by the disease, the violent paroxysms of coughing affect the intervertebral cartilages by concussing them repeatedly and rendering them liable, under the depressed powers of the system, to take on the ulcerative process. Any cause that vitiates the system, exposes these parts to take on this low grade of inflammation.

Age of patient.—The oldest case mentioned is thirty-five. We have had one patient who was quite-paralyzed by the disease at sixty-five, but several between thirty and forty years of age.

Dependent upon scrofula.—That this disease always originates from scrofula we cannot admit. It probably follows the same laws that govern disease of any other joint, viz.: where diseased action is excited in any joint, it is influenced by the peculiar diathesis and idiosyncrasy of the patient.

Let one person receive a traumatic injury of a joint—it is followed by simple or adhesive inflammation, and results in restoration of the joint in course of time. Another receives the same injury in the same locality, and suppuration and ulceration follow. Another, under the same circumstances, will be followed by tubercular development in the cancellous structure of the heads of the bones. These extremes may follow the same primary injury, and are dependent upon the causes above mentioned. This, we think, applies equally to all joints.

Why it forms an angle rather than a curve.—In health, each vertebra possesses six points of contact, or articulating surfaces—the upper and under side of each body—the four faces of the oblique processes, two facing upward and two downward. These are the points upon which the weight of the body and the pressure by the contracting muscles fall.

The articulation, of the oblique processes are seldom if ever diseased. Therefore, when the body of one vertebra, or the intervertebral cartilage is destroyed, this point of support is lost, the other articulations remaining intact; the next vertebra above, losing its anterior support, tips forward, the oblique processes being the fulcrum upon which it tilts. Ordinarily, the next vertebra above inclines forward and downward, until it reaches the one next below the one diseased.

Sometimes, however, the spine below the point diseased is forced backward, changing the form both above and below the diseased vertebra. This peculiar construction of each vertebra, but particularly the locality of the oblique articulations, should be kept in remembrance, for the reason that our mechanical treatment is based upon this peculiar arrangement of the articulations of the oblique processes, in reference to the locality of the disease. It should also be recollected that they, the oblique processes, are seldom if ever diseased. The advantage of this arrangement for applying mechanical treatment, was unknown until we pointed it out, and made use of the fact, by constructing suitable apparatus in accordance therewith.

Additional symptoms.—There is usually no difficulty in determining the existence of Pott's Disease after deformity has taken place, or an abscess has made its appearance, but by that time we find a considerable amount of damage, that cannot be entirely remedied. It is of great consideration, therefore, to discover the nature of the disease in its most incipient stage, before the health is impaired by it.

In addition to the symptoms already enumerated, the patient, if young, cries from very slight disturbances, either mental or physical; has usually an anxious expression of countenance, and handles the body with the care one would a member that was very painful and sensitive. Many patients walk more than naturally erect, keeping the feet very near the floor, the arms and shoulders often thrown back, apparently to save the muscular effort necessary to keep the body erect; for, as the disease advances, this difficulty of maintaining the trunk erect increases.

Any concussion of the spinal column, either through the limbs, or in sitting down, or riding, gives more or less pain, often causing a child to cry out. They not unfrequently scream out in the night, yet it is difficult to get them to locate the seat of the pain, or to give any reason for their cries.

The pains resemble those so common in morbus coxarius. The locality of the pain depends upon the part of the spine affected, and is a sure guide to the discovery of the particular vertebra implicated, as the pain occurs in the parts receiving nerves from that particular portion of the spine. It may occur in the nerves next above the vertebra affected, or in those below. This pain is referred to a distance from the spine, and is almost without exception in the muscles, but may be in the stomach or other internal organ possessing muscular fibres. Muscular action, as in coughing, crying, or laughing, often excites it, as it does in hip-disease, by producing concussion of the diseased surfaces.

The pain seizes the patient suddenly, and is often agonizing, yet it goes off quickly, leaving the patient perfectly free, unless it arises from some violence, when it will be more persistent.

There is a stiffness or semi-rigidity of the muscles most affected by the disease, especially in the morning, upon making the first efforts to move, or after sitting quietly for a long time, or if the patient falls asleep during the day. This affection of the muscles is very frequent in the first stages of morbus coxarius. But these symptoms are not all peculiar to the disease before deformity takes place. It is rather by the whole group of symptoms, than from any one or two single ones, that the diagnosis is to be made. Again, many of them cannot be accounted for by any local disease of the part apparently suffering. This is, perhaps, the most difficult disease, for one so common, that we are called upon to diagnosticate. Patients present themselves who have been treated for almost every disease in the catalogue. It is so difficult to decide, that not only the ordinary practitioner, but the most prominent and experienced are often at fault.

It is not an infrequent remark, in applications to us by letter, that "the doctors cannot decide what is the difficulty."

When this disease follows hooping-cough, it affects the middle dorsal vertebra, being localized at the point of greatest motion.

Scarlet fever, diphtheria, severe bowel complaints, typhus, in short, all diseases that reduce the vital energies, and vitiate the blood, predispose to it.

It is said by writers, that paralysis in this disease affects usually only the nerves of motion.

PARALYSIS.

We cannot recall a single case, among the large number of patients we have seen paralyzed by this disease, when the paralysis was complete, in which both sensation and motion were not involved. That the paralysis is from compression is evident from the fact that when the abscess points, it tends to relieve the paralysis; and in some cases where the matter lies under the fascia of the flexor muscles of the lower limbs, as evidenced by the fact that the limbs cannot be straightened, yet after treatment and the matter is absorbed, as shown by the gradually increasing ability to straighten the limbs, it is found that the paralysis has diminished.

Pressure may exist from the encroachment of the bony structure, or from thickening of the theca. There is no destruction of the chord, for this class of patients almost invariably recover from the paralysis. We have never treated but one case that did not entirely recover from the paralysis. In this there was destruction of the body of one of the middle dorsal, and one of the lower lumbar vertebræ. The patient was perfectly paralyzed below the seat of the disease for several months, motion and sensation both being involved, but he eventually recovered, with a slight remaining impairment of sensation and motion in the lower extremities.

ABSCESSES.

In addition to the several points of exit for pus in this disease enumerated by writers, it has perforated the lungs and been discharged by coughing. We have at present a patient with a permanent opening through the lungs, although there are several through the integuments of the back. We have had other cases in which the pus was evacuated both through the vagina and rectum. When it pursues a course toward the hip-joint, the latter will very probably be considered the seat of the disease. We have seen this mistake made by the most eminent surgeons.

DEVIATIONS OF THE SPINAL COLUMN.

Some writers assert that slight deviations of the spine will produce serious disturbance of the nervous system. This we conceive to be a great mistake. If the deformity is effected gradually and not by violence, the chord takes care of itself, as we see in various distortions of the spine, and we have never seen it suffer from this cause. This mistake appears to have arisen from the fact, that in some disturbances of the chord, as in the first stages of Pott's Disease, and in some diseases of the theca, the nerves are irritated, and, as a consequence, affect some of the spinal muscles, causing a semi-contraction ; or the irritation gives rise to pain in them, which induces the patient to put them at rest by relaxing them. It is the difficulty of the chord that produces the deformity, for one or more of the reasons mentioned, and not the deformity that affects the chord.

We have frequently had patients sent to us by members of the profession, under these circumstances, to be treated for the deformity of the spine. A case of this kind will be found narrated at the close of this chapter.

MASTURBATION.

Masturbation, or self-abuse, affects the spinal chord, occasionally increasing common sensation until it becomes painful. It also impairs the function of the nerves of motion. We have seen the lower limbs badly distorted as a consequence of this habit in children. Excessive venery in the adult has a similar effect. Instances of it in the lower animals have been observed, where the result has been most marked.

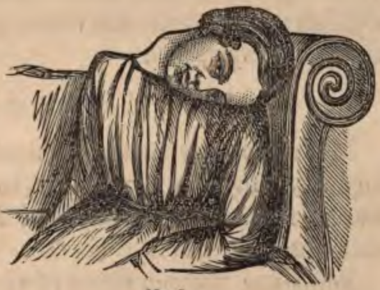
PROGNOSIS.

We have given in the preceding pages the opinions of members of the profession, that, in a large number of the cases of Pott's Disease, we must look for an unfavorable result, particularly so when the disease is situated in the cervical region. Our experience has been very different, as we stated before the Academy of Medicine in this city during a discussion upon morbus coxarius; it was, that a patient ought not to die if properly treated from the commencement, either from morbus coxarius, or Pott's Disease.

The mechanical treatment introduced by us *removes all constitutional irritation and pain* in those diseases.

The patient is thereby enabled to take out-door exercise, and eat, drink, sleep, and enjoy himself like others not so afflicted, and consequently there is no reason why this discase should be any more fatal than any other. Authors say that few recover where the cervical vertebræ are affected by this disease. We have had patients paralyzed below the place of disease in the cervical region, with the head hanging over to one side in front of the shoulder, as seen in cut No. 3. This patient recovered in less than six months, with a figure as represented in cut No. 4. the paralysis entirely removed. Others we have treated where the paralysis has been as great, but the deformity less. Before our introduction of the proper application of mechanical appliances to the treatment of this disease, such cases were in a great measure beyond the reach of our art. With the support which our apparatus affords, they are a more desirable class of patients to treat than when the disease is in the upper dorsal vertebræ.

No. 4.



No. 3.

In the cervical portion, the resistance from the muscles is slight and easily overcome, while in the dorsal we have the large muscles of the trunk as well as the weight of the head, and that portion of the trunk above the locality of the disease, to sustain by apparatus, while at the same time we have but a short lever in that portion of the spine above the point diseased, to use in bringing and sustaining the column in its normal position.

If the head is properly sustained and pressure removed from the diseased surfaces, it is not probable that matter will be formed more rapidly than it will be taken up by the absorbents; hence there will be no dangerous accumulation of pus, and without such accumulation, and its consequent pressure on the chord, there would be no imminent danger of a fatal result if the head were kept properly supported.

The head should never be left without proper supports for an instant, except when the patient is in the recumbent position, and then it may be sufficient merely to prevent rotation of the head. Any careless neglect of this caution may cost the life of the patient by instantaneously stopping respiration.

TREATMENT.

It was not our intention, neither can we consider it of any advantage to the reader, to here bring forward the means formerly recommended for treating mechanically this disease.

With our present views of the pathology, and our improved instruments and means for treating this difficulty, we can but look upon them as obsolete.

As we have remarked, our attention was first directed to the unphilosophical character of the apparatus for treating many difficulties, particularly those of the spine, before we commenced the study of medicine; in fact, it was this discovery which led to our devoting our life to the profession of medicine and surgery.

As would be natural for one entertaining these views, we were alive to everything bearing upon this subject, through our whole course as a student, and our first case was prior to graduation.

That the reader may be possessed of the data upon which we base our claims to the introduction of new principles in the treatment of deformities of the spine, we here give a history of what we have made known to the public.

In the *Boston Medical & Surgical Journal*, of the 3d of March, 1852, our first paper was published; in Vol. 47, No. 1, August 4th, 1852, followed another, entitled: *Cases of Curvature of the Spine*, at the close of which occurs the following statement:

"I have made no mention of any cases of caries of the vertebræ. The effect of treatment, in not only restoring the health, but the form, is as satisfactory in these cases as in lateral distortions. If time would permit, I would give the detail of some most interesting cases of recovery, in some of which there was perfect paralysis of the lower extremities; in one other, the amount of diseased surface was so great as to produce large abscesses on both sides, destroying the connection of a rib with the vertebra upon each side, leaving it so loose as to press against the skin."

This quotation is made to show that, in the early part of the year 1852, we had treated patients with success, upon the same mechanical principles that we have pursued ever since. We then made use of the spinal column as a lever, and the apparatus as another, the fulcrum for both being at the diseased or prominent vertebra.

In the March No. of the *American Medical Monthly*, for 1856, pages 210–214, in a paper on *Deformities and their Remedy*, we used the following language: "The common mode of constructing apparatus to sustain the weight of the body upon crutches is utterly useless, as the crutch impinges directly against the bundle of blood-vessels and nerves that meet in the axilla, upon which the weight of the arm even cannot be borne, much less that of any additional portion of the body." In the May No. of the same journal, page 327, we state that "the body and oblique processes afford the only perpendicular support to the spine," also give the reason why the deformity is angular, rather than a curve. After laying down this foundation, we give the principles of mechanical treatment in the following language:

"It is *this* form of the vertebræ which enables us to make use of the whole spinal column as a lever, to restore it. By apparatus, we are enabled to throw the entire weight of the superincumbent body upon the oblique processes, and thereby separate the bodies of the vertebræ adjoining that diseased, from it, the contact of which were constantly irritating each other, and producing absorption. This replacement is advantageous, not only by restoring the figure, but by the removal of all mechanical irritation and pressure, and in many cases it stops the disease at the same time."

These extracts show that the principle on which our treatment was based has not changed, and that it was made known to the profession through one of the best medical journals of New York city, as early as May, 1856, and its advantages had been published in the Boston journal, cited above, as early as August, 1852, thirteen years since.

We have been thus particular in giving the date of our first publications, and quotations from them, that the reader may judge of the character for fairness, not to say honesty, of the writer of the following quotations.

Extracts from a paper read before the New York State Medical Society, at its annual meeting in February, 1863, by Charles Fayette Taylor, M. D., and published in pamphlet form.

On page 18th, it stands in italics: "*We must relieve the pressure at the point of disease.*" Again, on page 19, he says: "In all the instruments which I have examined, there has been one idea on which their construction has been based. All these instruments are made with the one idea of making counter-extension from the hips to the shoulders. From a band around the waist, or resting on the hips, some form of crutches are erected to the arm-pits, and upon this slight support has all the relief to be derived from instrumental aids depended." It would be difficult to make a more false statement, as the reader can see by comparing it with the above extracts, quoted from *our* paper, published in the *Monthly* (for 1856), seven years previous—a journal with which we have good reason to believe he (Dr. T.) was familiar. To render this statement the more glaringly unjust, we, in 1858, took charge of some of this same Dr. Taylor's patients with this disease, to treat by apparatus, after he had endeavored in vain to benefit them by the "movement cure," which he advocated *at this* time as the *only proper way of treating the difficulty*, and we have a strong impression that he published these views, but we cannot at this moment put our hand upon it.

Now, we have no objection to a man's changing his opinions, but would rather commend him for it, particularly when they were wrong, as *he* acknowledges they were in this case. *What we do most decidedly object to, is, that after a man has combated our views of disease and treatment, he should adopt them, copy in a measure our apparatus, and then arrogantly claim the discovery and invention.* We can find no excuse in this case. His first apparatus was made while these patients were under our care, and he manifests guilt, by attempting, in this same paper, to give another (Dr. Sayre) credit for our discoveries and the consequent revolution it has effected in the treatment of morbus coxarius. The latter can only be accounted for by the supposition that there must be a fellow-feeling between them, they both having pursued the same unprofessional, if not to say dishonest, course toward us.

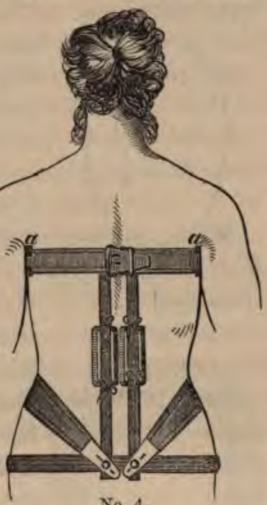
It is exceedingly unpleasant to say severe things against our professional brethren, but this imposture has been persisted in, and we fear advantage has been taken of our forbearance by these gentlemen, and they have arrogated to themselves more than they otherwise would. We do not feel called upon to sacrifice the labor of a lifetime, and allow such men by unblushing impudence to rob us of our just claims.

When the weight of the superincumbent portion of the body is thrown upon the healthy oblique processes of the spine, we have a natural articular support, and the diseased vertebral bodies are separated from each other. This separation relieves the patient from all suffering, according to the law discovered and made known to the profession by us, viz.: that the pain and irritation arising from ulcerated joints was owing principally to pressure upon the diseased surfaces, said pressure being produced by the contraction of muscles passing over said joint.

When these diseased surfaces are separated, there is no pressure or friction to prevent their healing, whereas before, the pressure interrupted nutrition, as strangulation from any other cause, while every motion of the parts upon each other brought the cancellated structure together like two millstones, grinding and destroying each other. The avoiding of this result is the reason why a patient can withstand this disease, and recover in a much shorter time than when not subject to this mode of treatment.

APPARATUS.

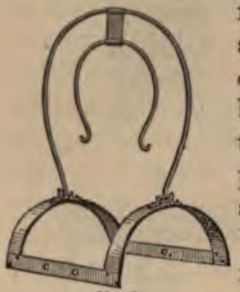
We give a cut representing one form of apparatus, or rather one mode of applying the principle we have laid down for treating this disease. There are two upright steels, placed from two to three inches apart, according to the size of the patient, secured at the bottom to a well-cushioned steel band around the pelvis. These upright steels are crossed at their upper extremity by a narrower steel band, that runs the width of the back under the arms, *a a*. The upright steels are secured to this, and at each end may be fastened a band of rubber webbing, that goes under the arms and is secured in front, or the webbing may pass through a loop as represented in the cut (marked *a*); this loop prevents the displacement of the webbing. On the upright steels movable pads are placed, to act as fulcrums, resting against the spine at the point diseased. These pads can be secured to the upright steels by tapes, or in any way the surgeon may choose, yet it should always be by some adjustable contrivance, by which their position can be changed, as may be found necessary during the progress of the case. The apparatus is held up (if necessary) by bands over the crest of the ilia, fastened to the pelvic band in front, and to the button-headed screws that secure the upright steels to the same band on the back; or, a convenient plan for children is to pass suspenders over the shoulders, and fasten at the same points as in the other way.



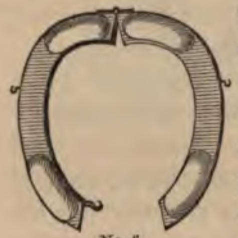
No. 4.

Cut No. 5 can be secured to the top of No. 4 for the purpose of supporting the head, for which an upright steel is necessary in No. 4. No. 6 is the part that goes around the neck and under the chin, and can be hooked to the small bow suspended in No. 5.

We have made apparatus with only one upright steel upon the back, and a pad fashioned like the saddle for the horse, avoiding pressure upon the spinous processes in the same way. We sometimes use an upright steel in front, to which the band under the arms is attached at the top. The steel *across* the back serves to prevent the band under the arms, when it is drawn tense to bring the body up, from compressing the chest laterally, and this arrangement applies the power exerted by this elastic band under the arms, more directly to the steels or levers upon the back. It will be seen that the pads are the fulcrum, while the upright steels, being secured at the bottom to the band around the pelvis, can be used as levers, and the elastic band under the arms acts as a power. Again, we use the spinal column as a lever, the projecting or diseased vertebræ being the fulcrum, and the band under the arms, as with the instrument, is the power to bring both the instrument and the spine together. It should be recollected that the upper rib, the one over which the band under the arms rests, is a strong, solid rib, designed by its form and connections to prevent the chest at this point from being crushed; therefore pressure at this point does not compress the chest. Again, its being unyielding renders it a much more desirable place to affix apparatus than the shoulders, that are held almost exclusively by muscles.



No. 5.



No. 6.

In this respect, Dr. Taylor has not copied our apparatus.

In his, however, he claims a great advantage from the joints in his back steels, as allowing the patient to straighten himself more than straight. Now, the great difficulty to be overcome in these cases *is*, to bring the spine into its normal or upright position, and if the patient *can do this*, and sustain himself so, we cannot see the necessity of his wearing *any* apparatus, or any benefit to accrue from it.

He also lays much stress upon the idea, that the patient can use the muscles to hold himself erect, or to aid in bringing himself so. This appears very plausible. There is only this difficulty; if the case is in any degree severe, the patient has *absolutely no power to do it.* He cannot make even the effort; he loses the ability, as in a fractured limb. Hence joints in an apparatus, to enable him to straighten himself by muscular effort, are utterly useless. As we are upon this subject, we will call attention to the injurious effect of *all apparatus* that depends upon compressing the body by tight lacing; it must necessarily possess all the objections to its use that tight lacing with corsets has; indeed, it is worse, inasmuch as the individual afflicted with caries of the vertebræ has less power and vitality to resist any injurious influence, and we have been surprised to see physicians recommend such contrivances, when at the same time they would condemn tight lacing with corsets—many of them are in fact corsets, with other stiffening than whalebone.

We use for the metallic portion of our apparatus the rolled cast steel. If any part is required to be very stiff and unyielding, the steel for such part can be corrugated. This should always be done where the deformity is so slight that the apparatus will bring the figure at once into its normal position. Where this can be done, the duty of the apparatus is limited to preventing a deformity, not to overcome one. Where there is a deformity to restore, then the upper portion of the back steels can be left as a spring, constantly acting to overcome it.

The rubber webbing under the arms performs the same office. The bands over the crest of the ilia are of rubber in the centre, that they may conform the more readily to the curve of the ilia, while the ends are of leather, to fasten upon the button screws, mentioned as securing the upright steels to the pelvic band. The upright steels are provided with two holes, an inch apart, for the purpose of altering the length, while the pelvic band has several holes in each end, half an inch apart, that the length may be changed. The pads can be stuffed with any elastic material, but we have used, with very satisfactory results, camel's hair, and the coarse wool used by carpet manufacturers.

It is not unfrequent that the process of straightening the spine, gives rise to spasmodic pain, similar in character to that experienced by the patient during the progress of the deformity. It probably arises from removing suddenly the strain upon the muscles, as is experienced in the knee when the limb has been laid up for some time.

If the parts under the pads and bands become irritated, but not abraded, the parts can be washed with spirits and water, in which alum has been dissolved. After drying, dust them with flesh-powder or powdered starch; care of this kind at first will save much future trouble. If cushions or compresses are applied on account of any abrasion, let them be by the side of the suffering part, not over it, as this would only increase the pressure. The recumbent posture, either upon the face or back, relieves the labor of the apparatus in sustaining the body, consequently renders it easier for the wearer.

When the instrument is applied to a child, the first week will be the severest time of trial. The child will be irritable, because its motions are restrained; after they become accustomed to it, they generally object to its being removed for even a change of linen. The apparatus should be worn *without intermission.* It does as much good during the night as the day.

The practitioner must not expect to treat his first or second case without meeting with many difficulties. It requires experience, and much of it, to meet all the little hindrances in the way of the successful treatment of a case. He should not commence with those that are severe, where there is much deformity, but let him attempt to treat those cases only where he has but to retain the spine in its normal position. If he has but occasional patients with this disease, it will be far better for them and for him that they be sent to some one who has more experience.

After the patient has worn apparatus for a few weeks, and has been free from paroxysms of pain during the time, he will begin to complain again; this is because the instrument has yielded, and does not afford the requisite support, which support should now be increased, not diminished, as the unskilled in its use generally recommend.

The constant motions of the child, bending the back steels, affects them as the continued bending back and forth of a piece of wire, gradually weakening them.

Case.—The following is given, as showing a peculiar phase of the disease. Miss W., aged 17, complexion light, general health delicate, appetite poor, has gradually lost flesh, complains of pain in the lumbar region, accompanied with a dragging sensation at epigastrium, has leucorrhœa, the left ilia drawn up, shortening the left limb two inches. Her disease was supposed, by those who had examined her, to be in the hip. Her walk and external appearance indicated this locality, but the other symptoms were wanting. The contraction of the limb upon the pelvis and the tilting of the latter were owing to the presence of pus under the fascia of the extensor muscles of the thigh, which eventually found exit below Poupart's ligament. The pain and dragging from the epigastrium were due undoubtedly to pressure upon the uterus, by the pus forcing it down or to one side. The leucorrhœa followed this disturbance of the uterus.

Our apparatus for Pott's Disease was applied, removing the pressure from the diseased vertebræ. The secretion of pus was diminished to that degree that the deformity of the limb and pelvis was soon removed, the general health improved rapidly, under the use of those tonics that affect primarily the nutritive system, aided by the mechanical support of the apparatus. She gained flesh rapidly.

She came to see me in September, saying that she could not return to her home (Alabama) without showing me how well she was, and how good her figure. Her appearance fully corroborated her words.

This was one of those cases that so often perplex and confound the practitioner, until deformity or an abscess indicates the locality of the disease. At the time of our examination, there was no appearance, locally, of any disease of the spine; the walk, &c., pointed to the hip as the seat of disease; but owing to the absence of all the other symptoms of morbus coxarius, and knowing that pus under the sheath of the flexor muscles gave rise to this peculiar deformity, we were at once led to the true locality of the source of her trouble.

Ulcerations of the last lumbar vertebræ, or yet lower, often give rise to anomalous symptoms, and frequently are considered cases of morbus coxarius, particularly when the region of the hip is the seat of the pain. The difficulty of diagnosing ulceration of the vertebræ in this vicinity is so great, that even the "Nestors" in our profession have been mistaken. If the disease occurs a little higher in the spinal column, they are generally termed cases of rheumatism, lumbago, sciatica, neuralgia, &c., &c., &c., according to the locality of the pain and the peculiarities of the case. We have repeatedly seen cases that had been treated for months for everything but the true difficulty.

RACHITIS AND OSTEOMALACIA.

THE exact nature of the deviations from health which culminate in softening of the osseous tissue, in infantile and adult life, being as yet obscure, we can only present some of the peculiarities, preliminary to pointing out certain applications of mechanism for the purpose of obviating deformities, and securing the normal shape of the skeleton, during the administration of suitable remedies to counteract, in individual cases and upon general principles, the diathesis upon which the disorders respectively may seem to depend.

Rachitis is conceded, from analyses of diseased bone, to consist in diminution of important elements which enter into the composition of the healthy tissue—especially of the carbonate and phosphate of lime—leaving a preponderance of the animal constituents.

Whether such change may be properly ascribed to hereditary influences—to scrofulous, scorbutic, or syphilitic taints—to atmospheric or miasmatic conditions, to insufficient and improper diet, to periosteal degeneration, first manifesting itself as resulting from any of the foregoing, or to antecedent disorders of the chylo-poietic viscera, interfering with the due supply of the calcareous item, are questions yet to be solved, and which we do not now purpose to discuss.

Rachitis is characterized by crookedness of the long bones and enlargement of their extremities, distortions of the spine, clavicles, ribs, and bones of the pelvis, tympanitic state of the abdomen, with flatulence and colicky pains, diarrhœa, flabby condition of the muscles, turbid, scanty, and lateritious urine.

In consequence of the impaired development, the bones of the lower extremity are often very much shorter than natural; and, if the child has been allowed to walk much, the head and neck of the femur may be bent by the weight of the body into a horizontal position, below the level of the great trochanter: the child becomes bow-legged, and the knee and ankle-joints become distorted.

Among the characteristics of rachitis, and one which enables us to diagnose it from osteomalacia, is the period of life at which it occurs—the former being peculiar to childhood, while the latter is confined to adult life.

Rachitis may even date as far back as intra-uterine life. It has been observed to prevail to the extent of an epidemic, making progress and decline in such manner as to give much coloring to the hypothesis of atmospheric influence.

Osteomalacia is a disease similar to rachitis, as regards softening of the osseous tissue, but differs in being confined to adult life, and in being almost always attended with pain, and generally progressing to a fatal issue, no apparent attempt at arrest and repair by nature being made, as in rachitis—the patient being eventually worn out by pain.

In osteomalacia, large quantities of calcareous phosphates are excreted in the urine, which does not pertain to rachitis. The bones, in osteomalacia, acquire a greater degree of suppleness than in rachitis, and, not acting as fixed points for the muscles to act upon, compel the patient to maintain the recumbent posture.

The proper time for mechanical appliances in these affections, and particularly in rachitis, is during the second stage, when the bones are about becoming bent by muscular contraction, and the action of the superimposed weight of the body in walking—the object being to maintain the osseous structure in normal shape, by counteracting muscular action, and taking from the spine and bones of the lower extremities, the weight of the body;

for, if the deformities are not prevented or overcome before the third stage, solidification of the osseous substance and permanent distortion will result.

TREATMENT.

In consequence of the great liability to distortions in cases of rachitis, it will be necessary for the surgeon, in their treatment, to be particularly watchful, in order to obviate the twistings of the joints and the bending of the long bones of the lower extremities; for, if these are allowed to progress to a great extent, their restoration will be found to be very difficult.

When, for instance, the distortion of the femur is allowed to go on, other causes will be brought into operation, and the absorption of portions of the joints by pressure will aggravate the difficulty.

Hence the importance of proper apparatus, applied in time, to prevent and counteract the contractions of muscles and the yielding of bones. If the child is able to walk, the lower limbs should be supported by the apparatus figured at pages 233 and 238, in order to secure the bones against alteration; and, if deformities of other portions, as of the spine, should supervene, the apparatus for curvature and spinal irritation will be applicable.

Deformities of the arms are not so frequent, as they are not required to sustain any great weight, as compared with the lower extremities and the spinal column.

Simple elastic extension to the limbs is all that is necessary to prevent their deformity, while the patient is confined to the prone position.

We had a severe case of this disease under our care the last winter. The young lady is 17 years old. The disease commenced in early childhood. When she first began to walk, nothing unnatural was observed, but within a year from that time some little irregularity was noticed in her gait, and, as the deformity increased, she was placed under the care of a medical gentleman of this city, under whose treatment the limbs were, in a measure, restored in proper position, but the process employed not having lengthened the soft tissues so as to leave the joints free, and the treatment being withal extremely painful, her limbs were left to resume their former position, so that nothing was gained in the end.

When she came under our care, the general health was fair, that is, she was never, as she said, sick. The countenance was rather waxy, flesh soft, eyes frequently inflamed, the lids swollen, bowels inclined to be constipated, the appetite fair.

The parents were both strumous, the mother having died with phthisis, and the father has been subject to occasional epileptic attacks. The whole figure of this patient is short, the limbs particularly so. She had double lateral curvature of the spine. The femurs were both twisted, and adducted, the outer condyles appearing to be absorbed about two-thirds of their depth. The head of each tibia was entirely removed from off the inner condyles, and their inner face absorbed to the depth of half an inch, where they were in contact with the outer condyle. The patellas were outside of the condyles, and the contraction of the extensor muscles attached to them served to draw the tibia outward and upward, respectively, and they stood at an angle of 45° to the femur, and were rotated outward.

One limb could be rotated half a circle, the toes of the foot could be pointed directly backward, and the patellas were very small, absorption having been going on for several years—showing that, when a part is not called upon to perform its function, it is not only not maintained in its original status, but is actually liable to become absorbed.

This is an important fact, and one which the surgeon should keep in mind in examining cases of deformities of long standing.

There is another equally important fact to remember, which is, that when the suspended function is restored to a part, the tissues necessary to the performance of that function will be produced. This may be regarded as the law. We see it in the formation of joints in new localities, and it has gone so far in some cases as to appear a special interposition of Providence. We have a case of congenital dislocation of the hip and knees, that undoubtedly took place in early fœtal life; at birth the tibias were lying upon the femurs, and no appearance of any patellas. The bones were reduced to proper position, and the patellas were immediately developed. We have reduced the femurs, and anticipate development of the head and neck. The law of growth has probably not been interfered with further than by the interruption of the functions, and we may reasonably ask why, having restored the function, we may not entertain the hope that the head and neck of the femurs will be developed, upon the same principle which governed the development of the patellas.

In cases of softening of the bones, it should be kept in mind that they may become so weakened that the simple contraction of muscles, without the weight of any portion of the body, will be sufficient to change their axis.

Moderate elastic extension will overcome the contractile force of the muscles, and thus prevent deformity from this cause.

We have also to guard against deformity from position, or by the weight of a portion of the body. The spine will become distorted if the patient is allowed to sit up, and in extreme cases a water bed will be the best resting-place for the patient.

The general principles of elastic extension, as applicable to the treatment of other deformities, are indicated here.

In the case mentioned, extension was employed until the ligaments and soft parts were sufficiently elongated to allow the joints to be brought into their proper place, when apparatus was applied to retain them *in situ*.

Our apparatus for extension of the limb in morbus coxarius answers for the lower limbs, while that for lateral curvature of the spine supplies the same necessity for the trunk.

Hygienic means are of the utmost importance also, and such tonics as promote the digestion and assimilation of food should be administered. It is in this function that the difficulty lies, and all our efforts should be directed to improve the nourishment of the patient, and thus enable the absorbents of the system to take up such constituents of bone as may be deficient.

The phosphates of lime, &c., are often useful, not simply because they furnish lime to the system, but because they in some way aid in the assimilation. There is no lack of lime in our food to supply the wants of the system, when we are in that state of health that admits of its elimination into the system.

The chloride of zinc is often beneficial, affording material for chemical combinations which result in benefit to the patient. The extract of nux vomica and the nitrate of silver combined we have found advantageous, and finally all that conduces to improve the general health and restore tone to the digestive organs will prove of great benefit.

SPINAL IRRITATION.

This is the term used to designate certain symptoms, more or less connected with some disturbance of the spinal cord; but it does not describe the affection.

Many practitioners suppose these symptoms are only the reflex manifestation of some local disease, especially of the uterus. There are undoubtedly two classes of cases—those dependent upon some local disease separate from the spine, and affecting the spinal cord by reflex action, and, secondly, those in which the meninges of the spinal cord itself are diseased.

In the former, the apparent difficulty of the spine is removed when the local difficulty in some other organ, from which it is reflected, is abated.

In the latter, the spine is relieved no further than it is treated locally. We give an illustrative case of each variety:—A physician's wife, from Ohio, came under our care, having been brought from her home upon a bed, being unable to ride sitting up, or to walk more than a few steps.

Her case had been pronounced disease of the spinal cord.

In my first examination of her case, I found a train of nervous symptoms which I have usually noticed as referable to some one of the several diseases or displacements of the uterus, sufficient to account, in our opinion, for the spinal disturbance.

Upon questioning her, she said there was no difficulty there; that she had been examined for it particularly by her former physician, who pronounced her free from uterine derangement, and she herself felt confident that she had never had any difficulty there.

This put a stop to further conversation on this subject.

We applied an apparatus to relieve the muscles of the spine, by affording artificial support, and administered constitutional treatment to invigorate the system, under which she improved, and became able to walk out for exercise.

While walking one day she stepped off the curb-stone, while her attention was diverted, and the distance down being greater than anticipated, it gave her a severe jar or concussion, causing such severe pain in her back as to render it very difficult for her to walk part of a block back to her boarding-place.

Calling soon after, she narrated her accident and the effect it produced. We immediately assured her that it settled one point, namely: that she had some uterine displacement. Our confidence induced her to consent to an examination. We found the uterus resting laterally across the pelvis. It was reinstated in proper position, and a ring pessary applied, by our friend Dr. Peaslee. The restoration of the uterus immediately relieved the pain in the back, and she was able to go up and down stairs with comparative ease.

In other cases, as a matter of experiment, we treated locally a portion of the affected spine, leaving the balance untreated, the general health being at the same time attended to. The result was, that the portion of the spine locally medicated was very much improved, while the other portion remained the same. Another fact, bearing upon the local origin of these spinal difficulties, is, that cases which we have treated by rest, counter-irritation, and general invigorating remedies, were benefited while they remained quiet, but as soon as they walked or rode the pain returned. Afterwards, we applied our apparatus to relieve the labor of the muscles in sustaining the body erect, while, at the same time, it prevented those shocks and jars to the spine, in exercising, which affect it so un-

PHTHISIS PULMONALIS.

It is with some hesitation that we attempt giving our views of this disease. This arises, not from any want of confidence in the principles upon which we base the treatment, or in the results that follow; these rest upon an experience of many years, and are not to be readily shaken. It is rather because we are aware that any innovator in our profession is looked upon with distrust; he is considered a fit mark for all his brethren to bestow that class of feelings upon of which they are not lavish toward their friends. He is exposed to all the fault-findings of all the fault-finders in the profession. An honest criticism, from a seeker after truth, should be courted, and no lover of truth would object to it; it is, in fact, for the accomplishment of the same purpose sought by the criticised; with such laborers we would cheerfully co-operate.

There is, perhaps, no disease which claims its victims from our households, in which the public are so ready to catch at any course of treatment which *promises* success, as in the one under consideration. There is scarcely a family, but has some member or some friend who is a subject of painful solicitude on account of the premonitory symptoms, or the actual access of this disease. Yet, if a member of the profession advances new opinions, particularly if they take a more favorable view of its amenability to treatment, they are not only discredited, but the author is looked upon with suspicion, his motives are questioned, and there is a lurking mistrust that it is but a bait to catch those who are hoping against hope.

On the other hand, a man may write volumes upon the subject, with the full approbation of the profession, and with credit to himself, provided his efforts extend no further than endeavors to illuminate the old, the venerable invalid, and perhaps bed-ridden, which makes the case much more serious.

This difficulty of the spinal chord is most apt to occur in persons predisposed to some form of struma, and therefore it is that medication should be employed to increase the vital energies.

These patients are very apt to become confirmed opium-eaters; being so continuously subject to pain, and to frequent exacerbations, they resort to it for relief, until the habit is formed. It is hardly necessary to suggest the importance, to the medical attendant, of bearing this in mind.

Sometimes a single bundle of nerves is affected, and pressure, or percussion along the spinous processes will detect its seat. The pain will indicate the seat of the disease in the chord, and vice versa. We have often seen vomiting induced by inordinate pressure upon the sides of the spinous processes over the origin of nerves distributed to the stomach.

When the pain in the back is sympathetic, treatment must be directed to the viscera involved, and giving rise to it by reflex action.

PHTHISIS PULMONALIS.

It is with some hesitation that we attempt giving our views of this disease. This arises, not from any want of confidence in the principles upon which we base the treatment, or in the results that follow; these rest upon an experience of many years, and are not to be readily shaken. It is rather because we are aware that any innovator in our profession is looked upon with distrust; he is considered a fit mark for all his brethren to bestow that class of feelings upon of which they are not lavish toward their friends. He is exposed to all the fault-findings of all the fault-finders in the profession. An honest criticism, from a seeker after truth, should be courted, and no lover of truth would object to it; it is, in fact, for the accomplishment of the same purpose sought by the criticised; with such laborers we would cheerfully co-operate.

There is, perhaps, no disease which claims its victims from our households, in which the public are so ready to catch at any course of treatment which *promises* success, as in the one under consideration. There is scarcely a family, but has some member or some friend who is a subject of painful solicitude on account of the premonitory symptoms, or the actual access of this disease. Yet, if a member of the profession advances new opinions, particularly if they take a more favorable view of its amenability to treatment, they are not only discredited, but the author is looked upon with suspicion, his motives are questioned, and there is a lurking mistrust that it is but a bait to catch those who are hoping against hope.

On the other hand, a man may write volumes upon the subject, with the full approbation of the profession, and with credit to himself, provided his efforts extend no further than endeavors to illuminate the old, the venerable path our fathers trod. Why is this? Not because medical men are of all men the most obtuse, as well as the most obstinate, or that they are not as desirous of curing this disease as the patient or his friends, but because they feel and are convinced that, when this disease has once taken possession, it goes not out until the spark of life goes with it.

The radical change which has been effected by our investigations in the treatment of diseases of the joints—a class of cases that formerly ranked with the profession next to phthisis, as to curability, also a similar change in the treatment of deformities, as well as other affections that come within the province of surgery—necessarily impairs our confidence in the perfection of our science, and compels us to believe that much which is at present received as truth, will be found in the future, at least open to criticism. It is one step in advance toward perceiving the necessity of seeking for more knowledge upon a subject, when we doubt the present received opinions; and it is a good mode of investigating *any* disease, but particularly one within the domain of surgery, to enter upon its study as though this were the first case of the kind, without even a reference to books or opinions.

Let me not be understood as discarding or undervaluing the literature or the labors of our profession. Far from it: we would simply endeavor to make every man an independent thinker and investigator. We would also suggest that every man, after he has read all within his reach upon any disease, and has thoroughly *digested* it, use this knowledge to *aid* him in his investigations, not to *decide* his opinions. There will necessarily be many things that we must take upon trust, as no one can examine minutely upon all points.

We would *discourage* the habit in our profession of taking *so much upon trust.* Let no one receive the opinions of others as decisive upon phenomena that are before him, unless, after close examination, he is unable to form an opinion, or his conclusions agree with those of others. Every man should be able to give a *reason* for his opinions, rather than an *authority*.

Before entering upon the discussion of the subject, there are several considerations that should be thoroughly examined.

It may at first appear incongruous to bring forward, in a work devoted to "mechanical surgery," a subject which has heretofore been considered exclusively within the domain of physic; but we trust it will be discovered in the sequel that this view is erroneous; that our best and most reliable resources for the cure of this disease are to be found under the head of mechanical remedies.

It has been for some time a well-settled opinion, that a low state of the vital energies is that condition of the system most favorable for the development of tubercle. It is also an established fact, though one not so well known as the former, that, other things being equal, *an animal digests and assimilates food just in proportion to the quantity of air he respires.* If these propositions are admitted, then it follows that if we have *diminished respiration, we must have diminished assimilation*, consequently a condition of the vital powers favorable to the development of tubercle. Again, if a depressed state of the powers of life favors the formation of tubercle, it follows that an exalted state of vitality becomes a serious, if not a fatal, obstacle to their development, and, if they are present, it not only prevents their degeneration, but actually necessitates their absorption.

From the foregoing conclusions, it is evident that much of our reliance for means of counteracting or curing phthisis must be upon a large amount of air-cells or lung, and, what is of equal importance, an ability to use them. Air-cells are of no use in the animal economy unless they perform their functions; if they are collapsed, or confined in a cavity so small that only a fractional portion of them can be brought into healthy exercise, then they are of no more consideration for the function of respiration than so much muscle.

The Creator has given us (and undoubtedly for a wise purpose) two lungs; these he has subdivided into lobes; an injury of one side of the chest, a punctured wound for instance, does not affect or impair the function of the other, but life can be sustained with one lung only. We infer from the fact that one lung is separated from the other, that the Almighty designed either lung to be of itself sufficient to support life under such accidental circumstances. We see in other instances, where organs are double, that either can perform all the functions usually effected by both when acting together. This is true of the eye, the ear, the brain, &c., &c.; therefore we cannot avoid the conclusion that, with a *well-developed chest, man has twice the volume of lungs necessary to support life.*

This is frequently demonstrated in the case of punctured wounds of the chest, and, in some instances, where the use of one lung has been destroyed by disease.

We have mentioned, as a well-established fact, that diminished vitality renders the system susceptible and predisposes to the development of tubercle; we would add that it also encourages and aids the ulcerative process. If this proposition is granted, we must at the same time admit its converse.

We have also stated that, other things being equal, animals digest and assimilate food in proportion to their respiration.

We have shown that the Creator has given man, for special reasons, duplicate lungs, or double the amount of air-cells necessary to sustain life, *provided* the cavities or laboratories in which they do their work are of such ample dimensions that they are not hindered or interrupted in accomplishing results equal to their full capacity.

If these propositions are correct, we perceive no element in the foundation, no reason to prevent our asserting that we have a *sure and broad basis* upon which to build *hopes of the curability of phthisis.*

It now remains to be considered whether the cavity of the chest *can* be enlarged to the requisite dimensions; and if so, *will* the lungs be enlarged, or the air-cells expanded or multiplied in proportion, or sufficiently so to fill it?

In another place we have demonstrated *how*, and under *what* circumstances, the soft tissues *can* be elongated to any reasonable length; therefore, if the diminished size of the chest is dependent upon this cause, we have entirely within our control the means of remedying it.

As a general description, the chest may be said to be the space enclosed by the ribs and their coverings, the sternum, and the diaphragm. The ribs unite with the spinal column by an articular surface, a point from which motion extends through their whole length. The first or upper one stands nearly at a right angle with the spine, and admits of but slight motion; below this they gradually increase in length, while at the same time they turn downward more and more, bringing their sternal ends, together with that bone (to which a portion of them are directly attached), near to the spinal column, when the air is expelled from the lungs; at the same time the diaphragm, which is attached to the margin of the lower ribs, is thrust up by the contents of the abdominal cavity, they being compressed by the contraction of the abdominal muscles.

In this condition we have the cavity of the chest reduced to its smallest capacity, consequently most of the air is expelled from the lungs, leaving the air-cells in a collapsed state. To enlarge the cavity of the chest, and thereby allow the air to inflate the lungs, the muscles contract, drawing upward the free end of the ribs (the other being articulated with the spinal column), while at the same time each rib rotates upon its ends, forcing the sternum farther from the spine, thus increasing the cavity inclosed by them. During this movement of the ribs, the diaphragm contracts, bringing its fibers straight, and increasing the cavity yet more, by lowering its base. This is, briefly, the mechanical process by which a vacuum is produced in the chest, the only entrance to which is through the trachea and bronchia to the lungs. The lungs lying pendent in this cavity, the air rushes in to fill the vacuum, and inflates them to the capacity of the chest. All this is, in one sense, simply a mechanical operation, similar to the production of a vacuum in a pair of bellows or an air-pump.

We have thus explained respiration as a mechanical process, that the reader may the more readily see and appreciate the necessity of a large chest (or cavity), in order that an individual may respire a large amount of air. This cavity is as essential to a full inspiration as a large volume of lungs, for the latter can accomplish nothing unless the cavity that contains them will admit of their full expansion.

But this is not all—there is another consideration of equal importance. A man may possess a large chest, naturally, taking its external dimensions, and yet be able to inhale but a small quantity of air. His chest resembles a large pair of bellows, with the handles confined so as to permit them to open but a short distance. It must be remembered that the amount of air respired depends upon the *vacuum* produced at each inspiration, so that it is evident we may possess a large chest and yet not be able to inhale as much air as a person with a chest smaller, yet admitting of free expansion. This fact should not be lost sight of, as it accounts for some persons succumbing to phthisis who are said originally to have possessed large chests.

A large chest, from long *disuse of its full power of expansion, may be so confined by a shortening of its ligaments, muscles, and other soft tissues, that it cannot be expanded to any thing near its full extent.*

This is in accordance with a law we have elsewhere explained; it will be seen by this, that a man, who by nature is furnished with a large respiratory apparatus, can, by only a partial use of it, gradually bring it down to the smallest compass, a point even below that of a small chest which can be fully expanded. This is another and important element to be taken into consideration in the treatment of phthisis. We must possess relatively not only a large chest and a large volume of lungs, but they should be kept in a condition in which they can be expanded to their fullest capacity.

From what has been said, it is evident that the best and most effectual method of enlarging the chest, and thereby the lungs, becomes a consideration of the highest importance. The processes that have been recommended for this purpose are innumerable, and as varied as their inventors. The principle upon which we propose to effect it was published in the American Medical Monthly, March, 1858, and is based upon the physiological and anatomical conditions involved in the act of respiration. It will be remembered that respiration is an involuntary act; it is performed and governed by nerves and muscles that are without our control; an animal cannot destroy his life by simply refraining from breathing, however strong his will or determined his resolution; there comes a time beyond which he cannot prevent the act of respiration, whatever may be his efforts to the contrary; therefore we say that it is without his control.

We caution the reader to keep this fact in mind, for it has a decided bearing in devising plans for enlarging the chest and increasing the volume of lungs. It is evident that, if respiration be an *involuntary* act, we must, in whatever we do, conform to the laws that govern it; our *voluntary* efforts to increase the amount of air respired should conform to the laws that govern the *involuntary* act, or there comes a strife, a clashing of effort, between the two; but the latter is sure to be victorious, and, like most victors, it suffers more or less exhaustion by the struggle. To test this, let any one force himself to breathe at a different order of time from what is natural for him at the time of the experiment—no matter whether it is faster or slower than is the standard fór him. He will find, after a few respirations, that the process is not an harmonious one; that there is a conflict of effort, and this conflict exhausts him. As we are aiming, in our treatment of this disease, to increase the vital powers, we should avoid any process by which the individual is prostrated; although he may have taken in more air than usual, and although he has been successful in increasing the respiration, he has done it at the expense of a loss of vitality, rather than a gain. The plan of drawing a full inspiration, retaining it, and by its rarefication expanding the air-cells, is not only open to the objection that it interferes and exhausts, but the person is, as it were, without the benefit of air during the time the air is retained in the lungs *beyond* the usual time of an *involuntary* respiration, as air will take up but such a proportion of carbon, however long it may be retained. The breathing through a tube, where the aperture is smaller than the orifice of the larynx, thereby obliging the person to make an extra muscular effort, has the same objection. Inhaling through a tube, in which the *inspiration* is free, but where the *expiration* is obstructed by a valve, is supposed to enlarge the lungs, by forcing the air into every air-cell by the violent efforts in compressing the chest to expel the air. By these plans, the air is retained beyond its capacity for effecting any healthful change in the blood; besides, it interferes with the natural time for inspiring and expiring, which interference, we have shown, fatigues and exhaústs.

Passing by many other plans of this character, for developing the chest, all of which are open to the same objections, we come to what are termed gymnastic exercises, for this purpose. Before entering upon an examination of these, we will review, so far as is necessary to elucidate our plan, the anatomy of the muscles, &c., connected with the act of respiration in these exercises. All the muscles that go to the arm are muscles that are brought more or less into use during *voluntary respiration;* they arise from the ribs or parts adjacent, and, when used in voluntary respiration, contract from the shoulder, this being held by muscles that pass from it to the neck. The clavicle, like a sweep, holds the head of the humerus away from the chest, while the cervical muscles draw it upward. In this position the muscles going to the arm contract, and draw the ribs upward, as in the act of *involuntary inspiration.* When the *shoulder* is the fixed point during the contraction of these muscles, *the chest is free*, and can be enlarged to the full extent the ligaments will admit.

We have said, that during *this* process of muscular action, the ribs are at liberty, and can be acted upon to enlarge the cavity of the chest; but suppose a man attempts to raise fifty pounds in each hand above his head, can he do it and leave his ribs free, or will he be compelled, in order to make the effort, to draw in his breath and retain it, thereby giving his ribs a support from the air inside, while the muscles of involuntary respiration hold them firmly in this position? Let any one who is in doubt test it by making the experiment. What is true in this act is true, in a degree, of every other, where these muscles act upon the arm, moving it in any direction. In all such motions, the chest is more or less firmly fixed. When they are slight, requiring but a small amount of muscular power, they may be effected without any perceptible confinement; but always when the effort comes in any degree near the whole muscular power, the chest must be fixed, as a point *from* which these muscles can act. We see the effect of this fixing of the chest, in a man who attempts to expend his entire strength in lifting a heavy body, by the deepened color of the face, caused by holding his breath. The man splitting wood often holds his breath until he has expended his effort, when, in consequence of having retained the air in the lungs beyond the regular time allotted by the involuntary nerves and muscles, he expels it suddenly, and not unfrequently audibly.

All the muscles that go to the arm have two sets of nerves of motion. When the arm is to be moved, the chest is held motionless, while the muscles contract, drawing the arm toward the body. The chest is the fixed point *from* which the muscle contracts, but when these muscles are called upon to contract in the opposite direction, then the shoulder is the fixed point, and the chest is left free to be moved by the muscles.

We have endeavored, by repeating this two-fold action of these muscles, and the condition of the parts to which they are attached during each of these processes, to fix it in the mind of the reader, that he may not lose sight of it when we come to use these facts in showing the true or philosophical method of developing the chest.

We are now prepared to make the inquiry, how can the chest be enlarged by any of those exercises, where the arm moves as it does in practising with the dumb-bells, the club, or in rowing, pulling up weights, &c., &c., movements in which the chest is more or less firmly fixed, and therefore cannot be enlarged while so held. An effort, to be effectual in enlarging the chest, must take place when its walls are unrestrained, when the power exerted will be expended upon it, while it is not trammeled by the contractions of any muscles that counteract its enlargement. This can be effected whenever we make the hands the fixed point, and draw the body toward them; the same effect upon the chest takes place also when the body is simply suspended by the arms.

In these positions, the weight of the body is suspended by the pectoral muscles, these acting upon the ribs, as in *voluntary inspiration*, drawing them up to the fullest extent their ligaments and other soft tissues will admit, and this without the fatigue or exhaustion consequent upon *voluntary* inspirations. A particular consideration in this process is, that it does not interfere in any way with the natural *involuntary* respiration; this goes on, as usual, without that interruption in time or sense of fatigue experienced when the chest is expanded by a *voluntary* effort. By this process there is just as much more air enters and escapes from the lungs than during ordinary respiration, as the cavity of the chest will hold when enlarged by the entire weight of the body. The only expenditure of nerve or muscular force is through the hands, in holding upon the bar. To give some idea of the increase in the amount of air respired under this process, we will give the experiments of a committee appointed by the British Association, of London, to report upon the best method of restoring asphyxiated persons. In this report, made in 1862, the plan is called Dr. Sylvester's, but it is the same mode of expanding the chest we published in the American Medical Monthly, of this city, in March, 1858, and reprinted in a pamphlet form, it will be observed, over four years before this report. Dr. Sanderson, another member of the committee, constructed an instrument for measuring the amount of air entering the lungs during their experiments upon the dead subject. By Dr. M. Hall's "ready method," the quantity of air moved in and out of the lungs rarely reached nine cubic inches, and never exceeded fifteen; whereas, by the plan we proposed in March, 1858, published in the American Medical Monthly, of this city, viz., by making use of the arms to expand the chest, the quantity reached as high as *fifty cubic inches*, five and a half times as much as by Marshall Hall's plan. We think the most skeptical must be convinced that this was a large amount of air to introduce into the lungs of a dead subject by any process at all simulating natural respiration, and at the same time it must be evident, if this same force is applied to the living subject, and does not interfere in any way with the ordinary involuntary respiration, it must increase, to a very great extent, the amount of air respired —a difference, in most cases, as great as between that during disease and that quantity sufficient for the enjoyment of the most perfect health.

We have introduced the results of this experiment to show the effect of this mode of acting upon the chest to enlarge it. It is as though every fiber of muscle was a fine thread attached to the ribs through their length, and the draft upon them made in the direction and in the manner best calculated to bring them upward and outward, as in the act of inspiration, thus enlarging the cavity of the chest to the extent that the weight of the body would, were it suspended over a pulley to these threads (muscular fibers). It should be remembered that this is in addition to the ordinary respiration; the function of involuntary respiration goes on the same as though the ribs were not raised by this great weight. As we have shown, this non-interference with the natural inspiration is one of the essential requisites to any plan for developing the lungs, and that any other mode fatigues and exhausts the system.

Exercise during phthisis has been objected to by some authors, from a fear of exciting the action of the heart, and that, through this increased frequency, the lungs would become congested, and the liability to hemorrhage increased. By this plan of ours, the whole process is changed. In the first place, the action of the heart is not materially accelerated; in the next place, the volume of lungs is very much enlarged to receive the blood, so that probably the pressure upon them is less than when not under the extension. Again, the action of the heart is rendered easier, inasmuch as the blood, as well as air, rushes into the lungs to fill the vacuum.

Instead, therefore, of its predisposing to hemorrhage, it actually prevents it. We see by this that not only the respiration is benefited by this process, but the circulation is made easier. It acts to increase the vigor of the heart, as a tonic whose primary effect is upon the circulation, or rather, it renders the labor of the heart less by diminishing the resistance.

The effect of this mode of expanding the chest is well illustrated by those subject to asthma. Most of those habitually subject to it have discovered that if they lean the head forward, resting it upon the hands on the back of a chair, leaving the chest suspended by the pectoral muscles, they can breathe much easier, and obtain, in this position, refreshing sleep. This relief is due entirely to the enlargement of the chest, by its weight hanging suspended by the pectoral muscles. If the position is changed, the respiration is impeded. It should be distinctly understood that this process of enlarging the chest by suspension from the arms calls for but a small outlay of nerve force; there are contractions only of the muscles of the hand, in holding on to the bar; beyond this, the weight of the body hangs upon the ligaments and muscles; even the contraction of the muscles of the hand we have often in a measure obviated, in persons that were very weak, by securing a band or handkerchief around the bar as close as the hand can be forced through it; this comes down upon the wrist; then the hand is placed upon the bar as before, yet without the effort to hold as when without the band around the wrist, the latter sustaining most of the weight.

It will be perceived that this plan gives the patient the benefit of full, free, and deep inspirations, with but a slight increase of nerve power, or exhaustion from the process; and the exercises can be continued for a number of minutes in succession, and then a short respite. There is a larger amount of air taken into the lungs at each inspiration than can possibly be done by the ordinary effort of *voluntary* inspiration.

If the patient feels equal to the task, the voluntary effort can be superadded. This can be done occasionally, but we should not advise its frequent repetition, particularly in the case of feeble subjects. It will scarcely be necessary to remind the reader that the air is forced into this vacuum by the weight of the atmosphere, which is computed to be fifteen pounds to the square inch, a force sufficient to open every permeable air-cell to its full capacity. The immediate effect of this plan of increasing the amount of respiratory power is, that the individual takes from one to two hundred per cent. more air into the lungs without any interruption of the frequency, and without any sense of fatigue, except in the arms; and this more a feeling of extreme extension of the soft parts, than that of exhaustion. Were the only advantage derived, that from an increased respiration for one-half or even one-quarter of the time, it would be invaluable to a person, dying in consequence of the respiration being diminished below the necessities of the system. But this is but a part of the benefit, and that of a temporary character.

This process should be continued until the chest has become permanently enlarged, and the lungs have developed until they fill this capacious cavity. This is done on the principle we have elsewhere explained, viz.: that the soft tissues elongate by the addition of new material, when they are retained in a *tense state.* This condition stimulates the nutrient vessels, and the growth is much more rapid than would be supposed. Again, this exercise increases the power of the muscles of respiration. We stated in the commencement of this article that the power of digesting food and assimilating it was in proportion to the quantity of air respired, other things being equal. Can we expect a patient to increase the quantity of food taken, one or two hundred per cent., the proportion we have given as the ratio of increase in the respiration, by this process? And can we expect them to increase in flesh and strength accordingly? We hesitate giving the results we have seen, because they are too startling to be believed by the profession or public, with their present views of the incurability of this disease. We have known a lady, feeble from disease of the lungs, gain ten pounds in weight in two weeks; and this was not a mere evanescent gain, but it continued until she had increased in weight twenty-eight pounds. This improvement was not confined to an increase of flesh merely; the muscular power, and the vitality of the whole system, was increased in proportion. This is not the result in a single case only, but is a general law. The result follows as certainly as the result follows any other law of the animal economy. We can rely upon it with as much confidence, and with as little fear of disappointment.

The profession will not mistake us. They will not suppose that, when the mesenteric glands are diseased, so as to cut off all reception of nourishment from the alimentary canal, we expect, by increasing the respiration, the patient will gain flesh. We stated that, other things being equal, this result would follow.

Dr. M'Cormac, of Belfast, Ireland, in his work on Consumption, says: "Tuberculous scrofulous deposits, then, whether in the offspring of scrofulous consumptive parents, or the offspring of persons free from scrofulous tuberculous disease, are alike; and in every case, owing to the insufficient, imperfect performance of the respiratory function, the carbon is retained—in other words, it is not discharged or sufficiently discharged from the blood in the lungs, and, finding no adequate outlet by the liver, skin, or other possible emunctories, being neither burnt off in the lungs, nor expended in the tissues, is deposited, mainly as a hydrocarbon, in the lungs and other organs, under the form of the bodies known by the designation of tubercles."

He attributes this imperfect decarbonization of the blood to the impurity of the air we breathe in our places of business and pleasure, but more particularly in our ill-ventilated sleeping apartments.

It is undoubtedly true that much impure air is respired, and that the consequences are as deleterious as he supposes; consequently, the subject deserves our highest consideration as a matter of hygiene. Yet we cannot think that all would escape phthisis, even should they never breathe impure air, granting that Dr. M'Cormac's views of the cause are correct.

The habits and employments of a large proportion of the community are such, that they require but a small amount of air to supply the wants of their system: the student, the accountant, the vast majority of females, particularly those confined to the needle, persons of sedentary habits, or those afflicted with ennui, require but a small amount of air to supply the needs of the system under such circumstances: their respiration is slight; the chest is seldom if ever expanded to its full capacity; it is limited, day after day and month after month, to this semi-developed state, and the consequence is, that the chest follows that law of the animal economy which limits the nourishment of a part to its uses. If a ligament, ordinarily three inches in length, be limited to a space between its origin and insertion of two inches, it will not be reproduced, in the ordinary process of nourishment, to any greater length than the duty it has to perform demands. The thorax is no exception to this law; if the ribs remain confined for months to a motion of half their capacity, the muscles and ligaments conform to this altered condition; the result is, the chest *cannot* be expanded to the extent designed, but only to that within the limits to which it has been confined. As we have before stated, the lungs conform to the cavity in which they are located, or in other words, they conform to the amount of labor they are called upon to perform. When the thorax has long remained in this contracted state, one in which there is just sufficient volume of lungs to support life, while no increased demand is made upon them beyond ordinary respiration, the individual may enjoy good health, but limited to this scale of labor; under these conditions, should he be exposed to impure air, or should any difficulty with the lungs occur, then the system must suffer just in proportion as the lungs fail of performing their office. It would immediately be below the point of sustaining itself, and must, of necessity, sink under it.

The full development of the chest, by the means we have proposed, provides against such contingencies.

If the capacity of the thorax has been increased to that extent that it contains a volume of lungs capable of performing double the service ordinarily required of them, then the extra quantity of air inhaled will be sufficient, when the individual is placed in an *impure* atmosphere, to furnish an amount of oxygen equal to the demands of the system; while in the other case, with a volume of lungs barely sufficient to supply the wants of the system when only a *pure* air is breathed, if placed in an unfavorable atmosphere, the body must necessarily yield under the deleterious influences of imperfectly aërated blood. Large lungs can be partially inflated, and thus perform a small amount of labor, but a contracted chest and a limited quantity of lungs cannot supply the place of the former, when called upon for increased service by the demands of the system. There is, however, an effort made to accomplish this by increasing the frequency of the respiration, as the capacity of the lungs diminishes.

This view of respiration deserves and demands from the profession a more careful consideration than it has heretofore received.

Without a large chest and a corresponding volume of lungs, all our medication in phthisis will be but palliative; but when we, by proper training, develop in our youth the full capacity of the respiratory apparatus, then the system will be in a condition to respond, and we may anticipate with confidence the most happy results whenever medication becomes necessary.

As we stated at the commencement of this chapter, a diminished vitality favors tubercular development; therefore this condition should immediately receive the attention of the physician. Medicines that increase the appetite and the power to assimilate food are to be administered; but there will be found no drug to equal, for this purpose, the exercise we have been recommending. Avoid in phthisis all that class of articles termed expectorants; they not only increase the secretions, but they diminish the appetite.

The nit. argente, in combination with some extract, particularly the ext. nux vom., will be found to diminish the secretion, increase the appetite, and, if night sweats are present, this preparation will check them. It is not unfrequently the case that persons with hectic fever will not tolerate tonics. If, however, they are conjoined with some form of opium, they will not disturb the system. Let me advise the practitioner to make the cough a secondary consideration. In so far as possible, treat the local disease of the lungs as though the same state of parts were upon the surface of the body. Who would ever suggest the giving of expectorants in the case of an ill-conditioned ulcer upon the surface? Put the system in the best possible condition to counteract this destructive tendency, and it will be found that the lungs will be amenable to the same law that governs superficial ulceration. When the chest is fully developed, if a sufficient amount of air-cells remain healthy, and the power of assimilation is at a healthy standard, then the ulceration of the lungs—like any superficial ulceration—will heal. There is no greater difficulty in healing a cavity in the lungs than one in a muscle, or in any other part, except that chronic diseases of the lungs occur in vitiated conditions of the system. Therefore, if we would heal a cavity in the lungs, we must bring the system to a healthy standard, and, as has before been stated, our chief dependence is upon developing the chest, and thereby the amount of healthy air-cells. This increases the power of assimilation, so that it is only the minor difficulties that we have to attend to, after the patient is put upon a system of exercise.

This exercise is not to be a pastime—an occasional recreation—a matter of amusement; but a labor, into which all the energies are thrown—labor and effort, such as a man makes when his life is in *immediate* danger. It should not be relinquished when a little weary; but the energies should be goaded to the last extremity. This applies more particularly to feeble persons, when they first commence the exercise; as they advance, it becomes easier. The more feeble the patient, the more urgent the need of the advantages to be derived from it. The practitioner must enjoin it upon the friends to encourage the patient by every means in their power to make the effort. We often find the mistaken kindness of friends a greater obstacle to overcome than the indisposition of the patient. The latter generally experiences so much relief to the breathing while exercising, that they are disposed to renew it frequently; while the friends are apt to think they "should rest more, that it is too laborious," &c. It is best to be governed by the clock—so many minutes to rest, and so many minutes to exercise. At first, if the patient is feeble, place him in a warm room, under the swing, on a high chair, so as to save, as much as possible, the labor of rising. As he improves, remove the swing to a *cold room*—even in winter; but the patient must not be idle a moment, and should leave for a warm room as soon as he is through exercising.

The more feeble and exhausted the patient is by the disease, the more urgent the necessity for effort. He is in the condition of the man in the water—exhausted, yet able, by words of encouragement, to hold out a little longer until relief is afforded. The moments are as precious and as pregnant with life or death in the one case as in the other. If the patient feels an appetite for food between the hours of the regular meals, it may be gratified; but the palate should not be mistaken for the appetite, neither should it be indulged at the expense of the regular meals. Patients are not unfrequently fed upon dainties, thereby excluding substantial food. In no case should food be allowed between meals, or dainties, such as fruit, &c., &c., be furnished, if it detracts from the appetite at the regular periods for taking food. These periods should be punctually observed, for the reason that the gastric and other fluids will be secreted at such times from habit, if the period is preserved with regularity.

It is not well to compel a patient always to eat a particular article of food, because certain articles are supposed to contain a larger amount of nutriment than others. An adult patient can eat whatever the *appetite craves*, or he feels will relish. It is the *appetite* that is to be consulted, and is to be the judge, and not the palate. A little wine with the food often promotes digestion.

The inquiry naturally arises, how much time should be spent in exercising? or rather it should be, what proportion of the time should be occupied in exercising? This will depend, at first, upon the strength of the patient. The more feeble, of course the less time he can exercise. At first, for a few days, he may only be able to hold on to the bar for one or two minutes; but it can be renewed again in five or ten minutes. This time can be gradually increased, and the interval proportionately shortened.

Hitherto we have spoken of the treatment as applicable only to confirmed phthisis. It is always better to *prevent* than to *cure* a disease, and in no instance is this more manifest than in the one under consideration. Every family has, to a certain extent, within its power to guard against, not only this, but all those diseases arising from diminished vitality. Every child should be made to exercise on this principle, viz.: making the hands the fixed point, suspending the body from them; under all circumstances leaving the weight hanging upon the pectoral and other muscles attached to the arm and scapula. In this position, the weight of the body must necessarily expand the chest to the fullest extent its ligaments will permit, while at the same time the ribs are not restrained by any of the muscles, but are at liberty and can be drawn up, as in the act of voluntary respiration. The parts to be affected by this exercise can be so, much more rapidly in the young subject than in the middle-aged, inasmuch as the growth is much more rapid in youth. Yet age is not a fatal barrier to the good effects of the treatment.

The question may very naturally be asked, What proportion of the ordinary cases of phthisis we should expect to cure or benefit by this mode of treatment?

The answer to this inquiry depends upon the same considerations that govern the results, when my mode of treatment is adopted in joint-diseases.

It was formerly more general than at present; but even now there are many in the profession who say that our plan of treating joint-diseases is only applicable to the last stages, after a considerable amount of destruction has been effected; or who will assert that, if the patient is not cured by the process in a given number of months, he never will be cured by it, &c., &c. All this interferes with a result that otherwise would be attained. We say, if a patient with the ordinary diseases of joints is from the commencement treated by our plan of "continued elastic extension," he should recover with a good joint, provided the treatment is continued, together with other appropriate remedies. When this mode of treatment becomes appreciated by the profession at its full value, this result will follow.

In like manner, when the treatment of phthisis we here propose commences with the disease, and is pursued uninterruptedly, we have every reason to expect that every case will recover. When the treatment is used as a prophylactic, every case will be prevented.

This may excite incredulity in the minds of most readers. It is but a few years since the results in the treatment of joint-diseases, now known to be attainable, were looked upon in the same light.

If the reader will follow the train of reasoning with which we commenced this subject, we cannot see how he can fail to be convinced.

We stated that tubercular deposit was the result of diminished vitality (this term is used in its broadest sense); that, other things being equal, persons digested and assimilated food in proportion to their respiration; that the Creator had given us (when the chest was developed to its fullest capacity) double the amount of lung or air-cells necessary to support life; that the capacity of the chest *can* be increased by exercise, and that the lungs will enlarge correspondingly. If these statements be true, how can we avoid the conclusion that phthisis is as much, if not more decidedly, within our control than most other diseases?

It is easy to give cases that corroborate any theory, and this has made the profession very skeptical in regard to new remedies or new theories. We can say we have as strong testimony, drawn from our own experience in the treatment of the disease, that phthisis is curable, as we have of the efficacy of our treatment in diseases of the joints. We have one fact capable of being investigated, that to our mind proves more than any array of cases, as the diagnosis in them might be erroneous, however honest the examiner; but it would be incredible to assert that a practitioner in general practice, in the center of New England, where phthisis is so common, should not have had a case of phthisis in thirteen years. Yet we can prove from the records of the town and from living witnesses that for thirteen years we had not one case of phthisis, commencing and terminating fatally, in the families upon which we attended.

It is obvious to our mind why this disease has been so irremediable. In every case of phthisis the causes have been operating for months, perhaps years, that eventually culminate in confirmed phthisis. This is the ordinary course. Sometimes it follows lung fever or some acute disease, when this produces the effect suddenly. The cause, we say, has been operating for months, that brings the person at last under the care of the physician. On examination, he finds not only tubercle, but tubercle softened, or perhaps cavities. Now, if the patient is cured of all the disease that *now* exists, what does it do for the condition that existed before the tubercular development? Does it remove the cause that brought the patient into that state in which he required treatment?

In ascites, we can remove the fluid; but does that save the patient? Certainly not. We must go back of *these results;* they but follow as a sequence of causes that have long been in operation. In cases of phthisis, it is generally a deficiency of useful air-cells; and unless we bring into use a sufficient number of these to fully perform this function, so requisite to health, we shall gain but a temporary advantage by medication. By restoring a full supply of air-cells, we not only restore *this function*, but we increase the power of assimilation in the same proportion. By this we gain a double advantage. The patient should be encouraged by every means within our power, consistent with truth; yet if the case is to be speedily fatal, the fact should not be withheld from him. Do not be anxious to get your patient out to "take the air," or to "ride out to make him feel better." The exercise proposed is worth more than *all* things else. The most ready way of arranging the apparatus for exercising is to make a triangle, one of whose sides will be formed by a wooden bar of convenient size for the hands of the patient, and 3½ or 4 feet long; the rope that forms the other two sides of the triangle to be secured at each end of the bar, and fastened to the ceiling by its middle. We have found a hook made from ¾-inch iron, with a coarse screw cut upon its shank, the most convenient; this can be put in the timber over head without marring the wall, and it is not so liable to be drawn out as one that is driven into the wood like a nail. The higher the walls, the longer will be the rope; consequently the swing will admit of freer motion, allowing a more general exercise to the body, as well as a greater variety to the action of the muscles. This may be advantageous to one who has acquired considerable muscular strength; but at first, simple suspension from the bar is all that is desirable. It should never be lost sight of, however, that the primary object is to enlarge the chest, and not to develop all of the muscles of the body. It is generally sufficient for a man that he possess a well-developed chest; other portions of the body will follow, as his business or pleasure may demand.

It is an absolute waste of time and material for the man who labors exclusively with his brain, to spend not only his time, but a portion of his nutriment, in developing large muscles; as all the nourishment that goes for this purpose is so much lost to the brain. A large chest enables the literary man to digest and assimilate a good supply of food; and as his pursuits do not require a large arm or leg, to cultivate them is to waste his nutriment upon parts that are subordinate in his vocation; while the brain—the portion of the system with which he labors—is deprived of just so much nutriment as he expends upon the muscles. This will be understood as applying to the full use, in either case, of all the nutriment supplied the system.

The views advanced in this chapter have been accumulating for thirty years, and the application of the principles has *never failed of producing results more or less favorable.* Therefore we consider them based on a sure foundation. It is difficult to make views that are mechanical in their application fully understood by the profession; we therefore entreat them to make full trial of our plans before they discard them—even though the why and wherefore may not be thoroughly understood.

HISTORY OF THE DEVELOPMENT OF THE TREATMENT OF JOINT DISEASES BY CONTINUED ELASTIC EXTENSION.

Circumstances, which in the sequel will be apparent, render it imperative upon me to place on record a true history of my claims to the discovery of some important facts in the Pathology of Joint Diseases, and the treatment based upon those facts. It has been stated in the preceding pages of this work, that for thirty years my attention has been directed to the observation of the effects of mechanical causes as influencing the frame of man, both in health and disease. The discovery was early made by me, that if the pressure were removed from the diseased vertebræ, in the treatment of ulcerated vertebral joints, or Potts' disease, it removed what was evidently the cause of the pain and constitutional irritation. This result being well established, by the treatment of numerous cases, my attention was further directed to the application of the principle to other joints.

In 1856, I had fully established the treatment of morbus coxarius, upon the plan of overcoming the pressure effected by the muscles, through the means of "*continued elastic extension*," and the mode with its results was very flatteringly commented upon by one of the editors of the *American Medical Monthly*, of this city, in March, 1857, page 187. In this article, the editor not only gives the principles of treatment, but a brief description of the apparatus by which it was accomplished. In November, 1859, I reported "A case of Potts' disease, with Remarks on Morbus Coxarius, &c.," in the *American Medical Monthly*. In the same year and month I published in the *New York Journal of Medicine* a paper "On the Effects of Pressure upon Ulcerated Vertebræ and in Morbus

Coxarius, and the Relief afforded by Mechanical Remedies, with Cases."

In April, 1860, I gave, in the *American Medical Monthly*, "The Mechanical Means adopted in the Treatment of Morbus Coxarius," in which was given a detailed description of my apparatus and its application, with a plate. In September, 1860, I read, before the New York Academy of Medicine, a paper on "The Pathological Basis of the Treatment of Joint Diseases," which was published. Thus, from 1856 to 1860, my plan of treating joint diseases by "*continued elastic extension*," together with the *pathology* upon which it was based, had been brought to the notice of the medical profession, through the medical journals of New York City, by the publication of the several different papers before enumerated.

In 1859, I sent out by a medical friend, who was intending to spend some months in England and upon the Continent, one of my splints for the treatment of morbus coxarius, accompanied with explanations in pamphlet form. In 1860, another medical gentleman took out three of my splints, with explanatory pamphlets, to exhibit at the different hospitals. The foregoing would appear sufficient to establish the date as well as the plan of treatment introduced by me for the treatment of joint diseases.

At the close of the year 1859, there came into my office an entire stranger to me, and introduced himself as Dr. Lewis A. Sayre, of this city (New York), saying that he came "to inquire about my mode of treating Hip Disease," remarking "*that he had heard much about it*, and would like to have it explained to him." I cheerfully complied with his request, explaining the principle upon which the treatment was based. I then took him to see a patient who had been under treatment some months, assisted him in making a full and thorough examination of everything that pertained to the treatment of the case. He expressed himself as highly pleased and gratified at the condition of the patient and the success of the treatment. He then wished me to visit a patient of his, upon whom he had operated, dividing the muscles, yet the joint was becoming as fixed as previous to the division of the tendons; the object of the visit being to see if my mode of treatment was applicable to that condition of a joint. After an examination and an affirmative answer, he desired me to apply one of my splints. This was afterward done, in the presence of the said Dr. Lewis A. Sayre and several medical gentlemen, commencing with the adhesive plasters, and fully explaining each successive step in the process; for which attention I received the following:—

In March, 1860, less than three months from the time I instructed Dr. Lewis A. Sayre fully as to the mode of treating Morbus Coxarius by "continued elastic extension," he presented for publication to the editor of the *American Medical Monthly*, then published in this city, a paper upon Morbus Coxarius, which paper was not published, however, until the next month (April). In this paper Dr. Lewis A. Sayre *claims as his own all the discoveries in the Pathology and treatment of joint diseases.* This, I am informed, was the *first paper ever published by* Dr. Sayre *upon the subject of Orthopædic Surgery.* In the May following, he read a paper before the *American Medical Association*, then in session at New Haven, Connecticut, upon Hip Disease, in which, as in his previous paper, *he claimed the discoveries as all his own*, not even alluding to having received so much as a suggestion from any one. *The paper was discussed at the time, and several gentlemen congratulated* Dr. Lewis A. Sayre *upon the importance of the discoveries* HE *had made*, all of which he received without a *word* of explanation.

When this paper was published, however, it contained a description of my splint, copied from the *American Medical Monthly*, 1860 (April No.), the same number in which his *first paper was published*, prefixed by the following:—"Dr. Davis was the first to invent a splint carrying out these views;" views which he has given as his own, accompanied by a cut of my splint, the same as given by me in the April No. of the *American Medical Monthly* for 1860, with this exception: it had been loaned to my *then* instrument makers for them to use in describing the splint in their circular, and they had added to it, "Dr. H. G. Davis's Splint for Hip Disease, as manufactured by Otto & Reynders, 58 Chatham Street, New York, since 1855." It will be noticed that this date is five years previous to that of the paper in which it was inserted.

About this time, when interrogated by a prominent surgeon of this city "how he came to think of this plan of treatment," he replied "*that he dreamt it out.*" This may account for the clouded state of his memory.

We next hear of Dr. Sayre as claiming the Pathology and the treatment based upon it, at Boston, Massachusetts, before members of the Sanitary Convention. Soon after, he read a paper before the Surgical Section of the New York Academy of Medicine, in which there was not so much as an allusion to any one as entertaining the same views. It was remarked by a member, at a subsequent meeting, in reference to this fraud practised upon the section, "No one would have known that Dr. Davis existed, much less that he had any thing to do with establishing the treatment; and, after the meeting closed, I went to Dr. Sayre and informed him that that was Dr. Davis's treatment, and he then refused to give him credit."

In addition, he caused my discoveries to be published as his own in the public papers of this city, and sent the same views abroad; and in all his published papers, in the medical journals, the reader is left *to infer* that the treatment and Pathology are all his own.

In conclusion, we give the remarks of Professor Alfred D. Post, chairman of a committee* of three prominent surgeons, appointed by the New York Academy of Medicine to investigate *my mode of treatment.* He says:—"This method is, undoubtedly, a *very great improvement upon all others which have preceded it. We have, in the method described by Dr. Davis, the* FIRST INTIMATION of extension being carried out in the treatment of this disease, through all its stages, in a manner calculated to relieve the suffering of the patient, to arrest the progress of the disease, and, at the same time, allow of active exercise in the open air." Again, he says:—"*There is no question* but that Dr. Davis *is entitled to the credit of having introduced this method of treatment to the profession*," and "*the methodical application of the treatment is due to Dr. Davis; and were it not for him the profession would have known* NOTHING *about it.*"†

Every honest man, I think, will acknowledge that circumstances rendered it imperative upon me to place on record a true history of my claims, as a matter of reference for all lovers of truth and science.

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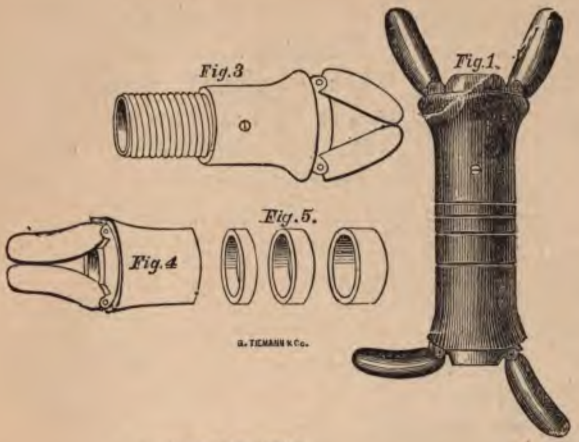
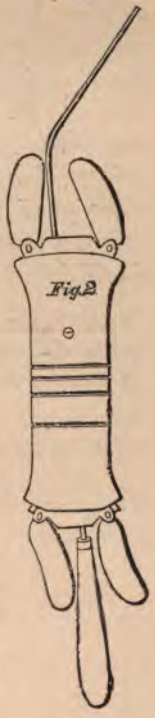
* The committee were Prof. Alfred D. Post, Prof. Willard Parker, and Dr. Gurdon Buck, Surgeon to the New York and St. Luke's Hospitals.

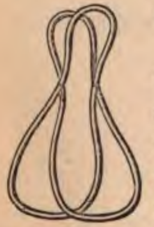
† *American Medical Times*, No. 17, Vol. II.



UTERINE CORRECTORS.

The two instruments here figured were invented by me, the first about four, the other about three years since. That figured in cuts 1 to 5 is constructed of hard rubber. There are two smaller and oval flanges for the support of the uterus; the two larger, when introduced within the vulva, open toward the ischia. The central barrel portion is a male and female screw, covered with rings, for changing the length of the instrument according to the length of the vagina. There are also very thin metallic rings that can be applied in order to secure the oval flanges in any position desired to support the uterus.





This instrument is simply two metallic rings, flattened, as shown in the cut, and crossing each other at about one-fourth their diameter. At this point they are secured by a rivet that forms part of a joint on each side. The length can be increased by flattening the sides, or shortened, by separating them. When introduced, the os rests between the smaller curves, and as both ends open and shut at the same time, it follows that the pressure of the uterus downward opens the lower portions or curve, thus preventing the escape of the instrument from the vagina.

To support the uterus antero-posteriorly, the instrument must be twisted upon itself, below the joints.

This instrument is very simple in its arrangement and very perfect in its application. Within certain limits, it can be shortened or elongated. By twisting it, the top can be changed so as to afford support to any malposition of the uterus. Both instruments elongate the vagina and secure the uterus permanently high up, where it can be held until the ligaments are permanently shortened, and the vagina contracted.

Both would seem to accomplish all that could be desired of any instrument; the latter is preferable from its simplicity. Silver is a good metal for the two rings.

A sound should be introduced through the instrument and into the os-uteri, by which the instrument is directed to its place. The sound should be retained in the os until the instrument is properly adjusted. The latter should not be removed for some months, unless it produces some unlooked-for irritation. It will be noticed that both these instruments elongate the vagina instead of dilating it, as was done by the old pessaries.

These correctors are made by Tieman & Co., Chatham Street, New York.

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